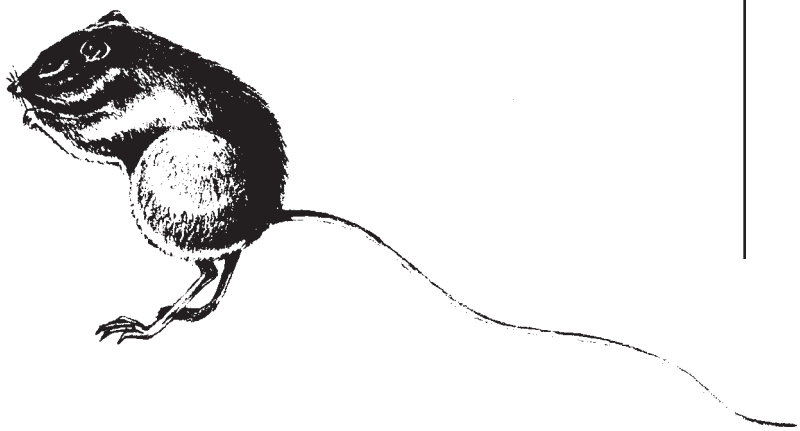


Chapter 3

Going Out: Field Activities

Planning a Bosque Field Trip

Successful field trips to the Rio Grande bosque depend on pre-planning. Here are recommendations and tips.

Practical Field Trip Tips for Educators

- Make reservations with agency to be visited for field trip.
- Complete individual school or district permission forms for field trip.
- Arrange transportation.
- Give informational letters to parents—include list of items for students to bring and an overview of the trip.
- Make a pre-visit to the site of field trip to be familiar with the area and to prepare student activities.
- Prepare *Bosque Education Guide* activities.
- Discuss with agency contact the purpose of field trip.
- Clear lunch or snack plans with host agency.

Things to Bring on a Field Trip

1. Children should be clearly labeled with first name, school name and telephone number.
2. Dress for the weather. **Winter** weather requires a water bottle and, as a minimum, a jacket; hat and gloves are recommended. **Summer** weather requires sunscreen, hat, water bottle and insect repellant. Long pants and sleeves protect against bosque shrubs; however, students should remain on trail away from these hazards. Shoes during any season should be sneakers or boots. Sandals are not appropriate for trail walking.
3. No snacks or lunches should be taken into the bosque. Wild animal diets don't include Twinkies, Cheetos, paper or straws.
4. Educators should have the paperwork required by their school for field trips, including emergency contact numbers, in their possession.
5. Students need to understand they are visiting another creature's home and should treat it with respect.
6. Water should be available in any season.
7. Journals, clipboards, paper, pencils, colored pencils, bingo cards or scavenger hunt lists can be brought. All should be secured in backpacks or other devices so they are not dropped and become more trail litter.

8. Bring a litter bag.
9. Bring cameras and binoculars
10. Bring a first-aid kit, but know your school's rules on liability.

Options

Here are some destinations for field trips. For details, see the separate handout.

Rio Grande Nature Center State Park

The City of Albuquerque Open Space Division

The Alameda Wetland

The Candelaria Farm

The Bosque Restoration Demonstration Site

The Rio Bravo Riverside Picnic Area

National Hispanic Cultural Center

Socorro Nature Area—Lemitar

Bosque del Apache National Wildlife Refuge

Los Padillas (Elementary School) **Wildlife Sanctuary**

Belen Consolidated Schools Educational Center (former Willie Chavez State Park)

1. Bosque Search Bingo

Description: Take a walk in the bosque using Bosque Search Bingo cards to help focus a discovery walk.

Objective: Students will discover and observe components of the bosque.

Materials: bingo cards (one for each student)

optional: colored pencils, markers or colors, construction paper, scissors, glue. You can laminate the finished cards and use markers that will easily rub or wash off; i.e. dry-erase or china markers, or use paper copies directly from this book.

Background: Here are some interesting facts you can share with your students about the things they may find.

Chewed leaves are mostly chewed by insects or other arthropods. The major group of animals that eat leaves in the bosque are pillbugs and woodlice. These arthropods were introduced into this ecosystem from Europe!

Cottonwood cotton is the seed of the cottonwood tree. The fine cotton-like fibers surrounding the tiny seed allow the wind and water to transport the seed. Cottonwood trees are either male or female. "Cottonless" cottonwood trees are male trees. Only female trees produce seeds; the developing female catkins are locally called *tetones* and resemble peas until they open. Cottonwood seeds or cotton "fly" in late May or June, but old cotton can be found year-round under logs or in crevices.

Rolled leaves are rolled by a caterpillar for its home. The caterpillar eventually becomes a small moth. These are commonly found in the Albuquerque area. They are less common further south.

1. Bosque Search Bingo

Grades: K–8

Time: material preparation: one class period if students prepare their own cards; otherwise only the time to make photocopies

field activity: 15 to 60 minutes

Subject: science

Terms: *aquatic, bosque, terrestrial, terminal bud scale*

Star twigs: Have students pick up a cottonwood twig from the ground. Find a terminal bud scale scar (See "Winter Bud Activity" for an illustration). It looks like a ring or collar that circles the twig. Snap the twig in two at this point. Look at the star shape formed by the pith of the twig, the cells in the center of the stem.

Procedure: Material preparation:

Included are two bingo cards and art to change the bingo cards to more accurately reflect the bosque near you. The Year-round Card (1) is for the Middle Rio Grande Valley, and items may be found in some shape or form year-round. The Seasonal Adaptations Card (2) features items found only during spring, summer or fall. Special Adaptation Squares (3) are for (a) upper or (b) lower river adaptations; (c) special seasons items can be used in winter or spring.

Copy a Bosque Search Bingo page for each student. Optional: have students color the page, then cut it apart. Mix up the pieces and glue them on a piece of construction paper. Laminate them for future use, or copy and laminate one of the cards provided. Paper copies can be placed in a student notebook when finished.

There are areas of the bosque where students can get disoriented and lost. Set limits, such as a physical area, for students to obey. "You must stay between this road, the jetty jacks and the river," "within sight of the teachers" or "behind one teacher and in front of another." This activity encourages exploration, but safety should also be a concern.

Go to the bosque. Hand out bingo cards and markers, and start your walk. See how many items you can find. If it is easy, then try to find all items on the card. Discuss the activity as a group. What was the easiest item to find? What was the most difficult item to find? Did anyone find it? What was most interesting? What was most surprising? Did you find anything else of interest while you were looking for things on your card?

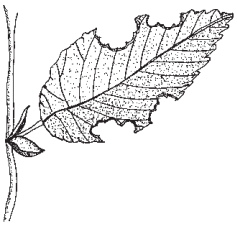
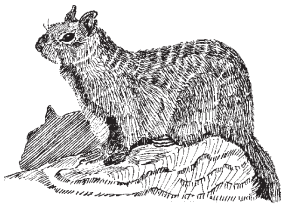
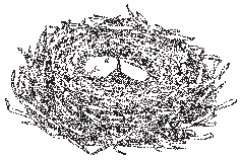
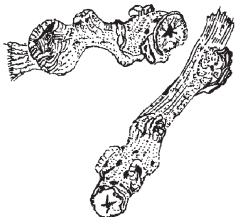
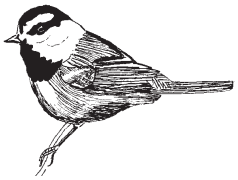
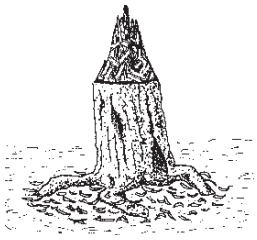
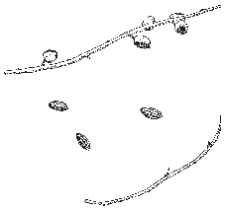
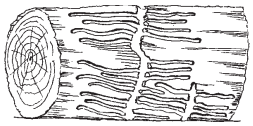
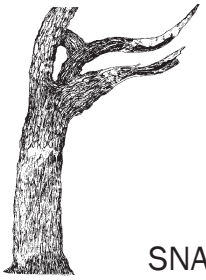
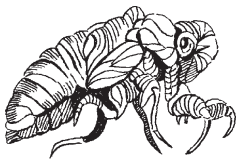
Assessment: Participation in the activity with the group.

Extension: Use one page of the Bosque Discovery Booklet for students to examine and discover in more detail the components of the bosque. Students may draw and write observations about one of the bosque bingo components.

Bosque Search Bingo

Drawings by Gregory Scheib and George Mauro

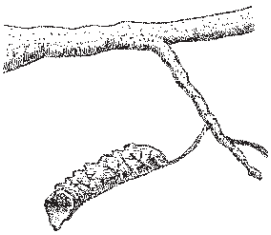
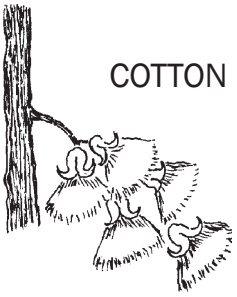
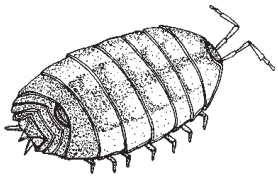
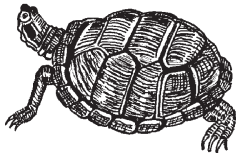
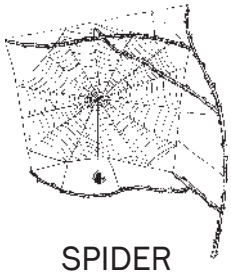
1. Year-round Bosque Bingo Card

 CHEWED LEAF	 SQUIRREL	 ANIMAL BURROW	 BIRD NEST
 COTTONWOOD STAR TWIGS	 ANIMAL TRACKS	 PERCHING BIRD	 BEAVER TREE
 SANDY SOIL	 COTTONWOOD LEAF	 RUSSIAN OLIVE SEEDS	 BARK BEETLE TRACKS
 SNAG	 ANIMAL PELLETS	 CICADA SHELLS	 CANADA GOOSE

Bosque Search Bingo

Drawings by Gregory Scheib and George Mauro

2. Seasonal Adaptations Card: Spring, Summer Fall

 ANT	 GRASSHOPPER	 HUMMINGBIRD	 YELLOW LEAF
 SALT DEPOSIT	 COTTONWOOD LEAF	 ROLLED LEAF	 COTTON
 LIZARD	 DRAGONFLY	 PILLBUG	FREE SQUARE
 TURTLE	 FEATHER	 SPIDER	 AQUATIC INSECT

3. Special Adaptations Squares

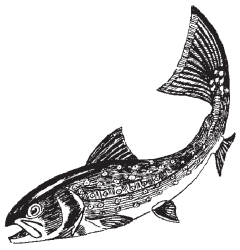
a. Upper River


ELK

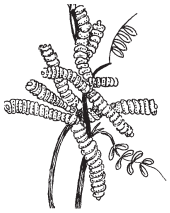

ALDER

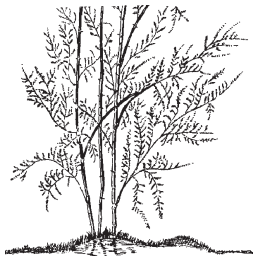

DIPPER


BEAVER LODGE


TROUT

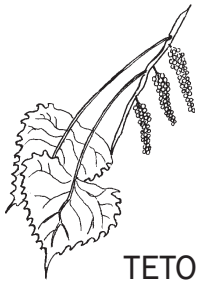
b. Lower River


SCREWBEAN
MESQUITE


TAMARISK

c. Special Seasons


MALE CATKINS


TETONES


SANDHILL CRANE

2. Bosque Discovery Booklet

Description: Students participate in an active discovery experience guided by their own Bosque Discovery Booklets, and are encouraged to record observations of what they find.

Objectives: Bosque Discovery Booklets will:

- introduce students to the bosque environment;
- enhance observational skills and sensory awareness; and
- encourage an excitement for learning more about the bosque through an active, guided exploration.

Materials: a booklet for each student (masters included in this activity; copies consist of two double-sided pages for each student)

stapler for stitching booklet together

scissors or paper cutter

construction paper for cover (optional)

journal tools such as colored pencils, charcoal or crayons for bark rubbings, glue sticks, tape, pens, etc.

Procedure:

1. Prepare booklets ahead of time. To keep the idea "new" to the students, you may wish to ask parents or volunteers to help assemble these.
   a. Copy the master sheets as two-sided copies making sure to keep the pages and orientations as they are in this guide. (Optional: add an additional blank sheet.)
   b. Fold the two pages in half and in half again as in the diagram below. (Optional: add a 5.75" x 8.75" piece of construction paper to the outside of the booklet as a cover.)
   c. Staple the center of the booklet along the fold.

2. Bosque Discovery Booklet

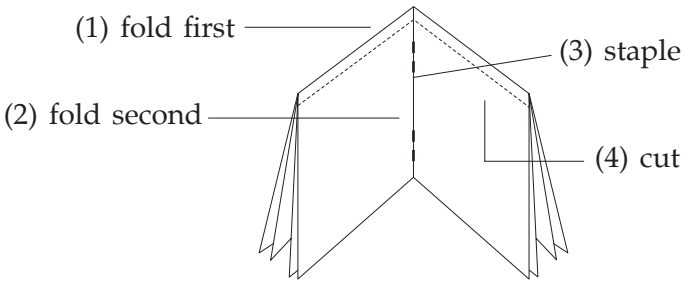
Grades: 1–5

Time: Material preparation: about one hour to make 20 journals. Class activity: flexible. This is a field trip, requiring time to plan your destination, plan transportation, etc. Allow at least one hour for the activity itself when in the bosque.

Subjects: science, English, art

Terms: *bosque, journal*

d. With scissors, cut the tops of the pages to create a 16-page booklet (or 24-page booklet if a blank page was included).
e. You may want to personalize with the student's name on the cover.



2. Tell the students before the trip that you will be going on a Discovery Hike and that they will get to experience the bosque in an exciting new way, but don't tell them the specifics of the activities in the book before the trip.
3. On your trip to the bosque, tell students that they will now get to be Bosque Discoverers, and they will get to go out and explore the forest in a fun way, rather like a scavenger hunt. They will have things to find, things to do, things to observe. Then give each student a Discovery Booklet. Explain that this booklet is a journal for the students to record their own observations. They should do the things on each page, and they can write responses, draw pictures, tape in leaves, and so on in the spaces provided. They may use the blank pages in any way they wish. Emphasize that there are no right or wrong answers. They should be encouraged to write or draw what they see or think or feel. Don't worry if they don't fill up the entire book—the purpose is to get them out and looking around.
4. Set a few ground rules at the beginning of the hike. In addition to your personal class rules for discipline, you need to set some guidelines for how to treat the bosque. You may want to let the students develop their own rules but guide the discussion to include the following:
   a. Use walking feet and quiet voices so as not to disturb animals.
   b. When students find something that they want to share, let them do so but please return everything (except trash!) to the place where they find it. Point out that many organisms (animals, plants) live in the bosque and that you are visitors in their home. Everything belongs there and should

be left, whether it is a rock, a feather or a piece of bark. The exceptions will be leaves that they may wish to tape into their booklets as indicated.

c. Please do not pick living plants. If students take leaves to put in their booklets, they should only take one leaf from each plant. Encourage students to take leaves from different individual plants than their friends, or, better yet, pick up leaves from the ground rather than from living plants.
d. When walking, take care not to trample the plants.
e. Be gentle with any creatures you might pick up. Please discourage squashing spiders or stepping on ants; remind the students that these creatures are living beings just as we are.

5. Once students receive their booklets and start discovering, your main job will be to keep them on track. Encourage exploration, encourage experiencing. Check to be sure that they get something down on paper, but let the students use the method they prefer, whether writing or drawing. Keep track of potentially hazardous or destructive behavior.
6. We hope that you will be in an area where you can go off established trails. If you are in a place like the Rio Grande Nature Center, please inquire ahead of time as to where you might be allowed to go off the trails. Do not permit excessive trampling in any one area, but rather minimize impact while still experiencing the bosque as fully as possible.
7. At the end of the walk, point out that the students now have more knowledge about this wonderful place. Use the enthusiasm they now have to get them excited about the upcoming classroom activities.

Related Activities: Although this activity is similar to the "Field Explorations Booklet," the focus here is on observation skills, while the latter focuses on helping students think about the bosque.

Assessment: Have students share a part of their booklet with the class. Have students hand in booklets and review them. Send booklets home with the students to show their parents.

Extensions: Add a blank sheet of paper between the two master sheets to provide a 24-page booklet with eight blank pages.

For younger students, use only one or two pages, enlarged on the copier, as the focus for a trip.

Follow-up Activity: This should be followed by the "Changing River" activity.

Find a comfortable place near a tree or a bush and sit quietly for several minutes. *Use letters or symbols to describe the sounds that you hear*, but don't try to name what is making the sounds.

Grab a handful of leaves from the forest floor. *Smell their rich scent.* Try to find other interesting smells in the bosque. Draw pictures or use words to describe several of these.

Find a Friend . . .

Find a natural object that can fit in your hand such as a rock, leaf or feather, or anything that looks neat. Get to know it. How does it feel? How does it smell? What colors do you see? Carry your friend with you for a while, but *be sure to return it to its bosque home before you leave.* Draw a picture of your friend here, or use words to describe it.

My Bosque Discovery Booklet

Name ____________________

Date ____________________

Look at all the different kinds of ants in the bosque. Can you find where they are? Look on the ground, in trees, in bushes—anywhere! *List some differences you see among the ants.* Shape? Color? Size? Location?

Can you make a rainbow?

See how many colors you can find around you. Glue or tape samples here to create your own rainbow. Use colored pencils to capture colors for those you cannot catch, like the sky or a butterfly.

How many shapes of leaves can you find? Can you find a lacy leaf? Tape some here or draw their pictures.

Walk near the edge of the river (*carefully*). Which way is the water flowing? Where do you think the water comes from?

A drop of rain that falls in southern Colorado could float all the way to the sea
. . .
What about a drop of rain that falls on Sandia Peak?

Where are all the animals? They are all around us, but we often don't see them. Still, we can find signs that they were near. Look for signs of animals . . .

a feather

a footprint on the trail

a chewed leaf

a hole in the ground

some scat

Dig down under the layer of leaves on the forest floor. Use a magnifying glass to look for small treasures there. Draw pictures or use words to describe several of the neat things that you find.

Find a tree with rough bark. How does it feel against your hand? Against your cheek?

Find several other interesting textures and draw pictures or use words to describe them here.

Find a large tree with heart-shaped leaves. Stand with your back against its trunk and see how its branches seem to reach to the sky.

Pretend you are a tree and reach your branches up into the sky. How does it feel to be a tree?

Dig your roots down deep and sway with the wind. Could you stand strong against winter storms?

Would you like to provide a home for birds and insects and spiders and mammals and lots of other critters?

Can you find the skin of an animal that looks like this? Where did you find it?

How many legs did the animal have? Can you tell what kind of animal it was, based on the number of legs?

Many of the critters in the bosque are tiny, so their view of the world is very different from ours.

Lie down on the ground and look up to the sky. How does the forest look from this viewpoint?

Have you seen anything that doesn't seem to belong in the bosque? Draw or describe it (or them) here.

Animals live throughout the bosque. *Can you find evidence of their homes?* Draw some here or use words to describe them.

3. *Field Explorations Booklet*

Description: Students take a creative journal to the field. It has ideas and questions about things found in the bosque, and lots of space for the students' own ideas, questions, and drawings.

Objective: Enhance the students' observations, feelings, and connections with the bosque through writing, drawing, and thinking about the bosque.

Materials:

1. a booklet for each student (masters included in this activity; copies consist of two double-sided pages for each student)
2. stapler for stitching booklet together
3. scissors or paper cutter
4. construction paper for cover (optional)
5. journal tools such as colored pencils, charcoal or crayons for bark rubbings, glue sticks, tape, pens, etc.

Procedure:

1. Prepare booklets ahead of time or as an in-class project.
   a. Copy the master sheets as two-sided copies making sure to keep the pages and orientations as they are in this guide.
   b. Fold the two pages in half and in half again as in the diagram below. (Optional: add a 5.75″ by 8.75″ piece of construction paper to the outside of the booklet as a cover.)
   c Staple the center of the book along the fold.
   d. With scissors, cut the tops of the pages to create a 16-page booklet.

3. Field Explorations Booklet

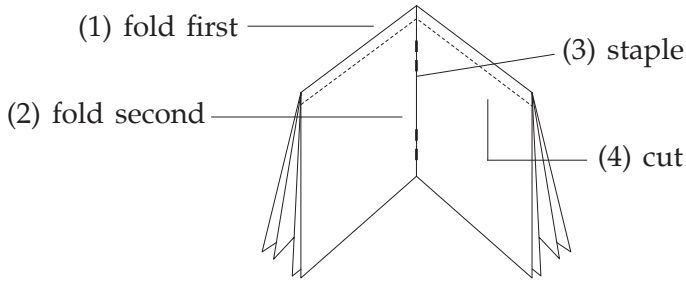
Grades: 3–8

Time: Material preparation: about one hour to make 20 journals

Class activity: flexible. This is a field activity. As a break between other activities, the journaling time could be allocated in 10-minute blocks, or the journal can be the focus of a several-hour hike or exploration.

Subjects: science, English, art

Terms: *journal, tamarisk, pillbugs, jetty jacks, soil stabilization, mosquito fish*



2. On your trip to the bosque, give students the journals and materials to write, draw, or tape things in their booklet. Start the activity with:

   This booklet is a special journal. See if you can find everything mentioned in this booklet.

   Each page of this journal has a theme. Figure out the theme on each page, and decide if that thing found in the bosque is here naturally (native) or because of human influences (exotic).

   Here are some ideas for using the booklet page by page. Don't let these ideas stifle your own or your students' imaginations! Because of copying complexities, page numbers may not match, but it doesn't really matter as long as the cover page is first!

   Page 2: Theme: wildflowers. Find an insect on a flower, and write a short tale about what that bug is doing there.

   Page 3: Theme: large cottonwood tree (native). With a light-colored chalk or crayon, make a bark rubbing of a cottonwood tree.

   Page 4: Theme: songbirds (native). Sit quietly in the forest with your eyes closed. Can you hear some birds? What sounds are they making? Try to write down the sounds that you hear.

   Page 5: Theme: lizards (native). Be a lizard detective. How many lizards can you find? Are lizards easy to see? Why or why not?

   Page 6: Theme: mosquito fish (exotic and native). When looking at water, look for small fish swimming around. Ask students to construct a food web, linking mosquito fish to the sun and to large animals like eagles, bears or us!

   Page 7: Theme: mosquito (native). Think about making peace with the mosquitoes. Mosquitoes pollinate the flowers.

   Page 8: Theme: saltcedar or tamarisk (exotic). Tape a saltcedar leaf on this page, write about a saltcedar or write down how many colors of saltcedar leaves you can find.

Page 9: Theme: isopods (exotic). Let the pillbugs and sowbugs crawl on your arms. What does it feel like? See The Pill Bug Project in reference list for activity ideas.

Page 10: Theme: decaying cottonwood leaves. Use your nose. What do you think of when you smell old leaves? Tape old leaves in your book. Do they still smell the same?

Page 11: Theme: fire. Think about fires in the bosque. Can you find any signs (like charred wood, dead, blackened trees, etc.) of recent fires? Are fires good or bad for the bosque? Can fires be prevented? How?

page 12: Theme: cottonwood seedlings (native, but lack of them reflects altered conditions). Hint: look near wet spots, like along ditches, drains, banks and sand bars on the river. Also look for young sprouts from dead and dying trunks and stumps. If you find a few cottonwood seedlings, does that mean that there will be as many cottonwood trees in the future as there are now?

page 13: Theme: your page. Immortalize your favorite event of the day. Tape in something. Write a poem. Draw a picture.

Page 14: Theme: aquatic insect exploration (native). Bring pans or plates for this activity. Nets and waders are also fun. Hand lenses and microscopes really make this activity more exciting. Have students try to see how many different critters they can identify. Explain that generally more kinds of aquatic insects indicate healthier water environments.

Page 15: Theme: jetty jacks. Carefully explore around a jetty jack. What can you find? Write about or draw what you see.

Related Activities: Although this activity is similar to the "Bosque Discovery Booklet," this activity's focus is on helping the student think about the bosque, while the Discovery Booklet focuses on observation skills.

Assessment: Have students share a part of their journal with the class. Have students hand in booklets and review them. Send booklets home with the students to show their parents.

Extensions: Add a blank sheet of paper between the two master sheets to provide a 24-page booklet with eight blank pages.

For younger students, use only one or two pages, enlarged on the copier, as the focus for a trip.

How many pillbugs can crawl on my arm at the same time?

tiny intruder, eater of leaves
protected in a ball of armor
there are so many of you

graceful, feathery leaves
brilliant pink blossoms
wispy branches bend and sway

This field booklet belongs to:

____

My Bosque Field Booklet

Ouch! Who keeps biting me . . .
Would I rather you weren't around?
Then who would pollinate the flowers?
Then who would feed the bats and fish?
Oh bother, next time I'll wear more clothes.

I love the smell
of decaying cottonwood
leaves
on the forest floor

rich
earthy
friendly

Wildflower
Thing of beauty
who depends on you
for your sweet nectar
for your plump pollen
for your succulent tissues
for your energy-packed seeds
You are so much more than
a thing of beauty
Wildflower

Jetty jacks. Soil stabilization.

I found a wasp's nest in one of these one time.

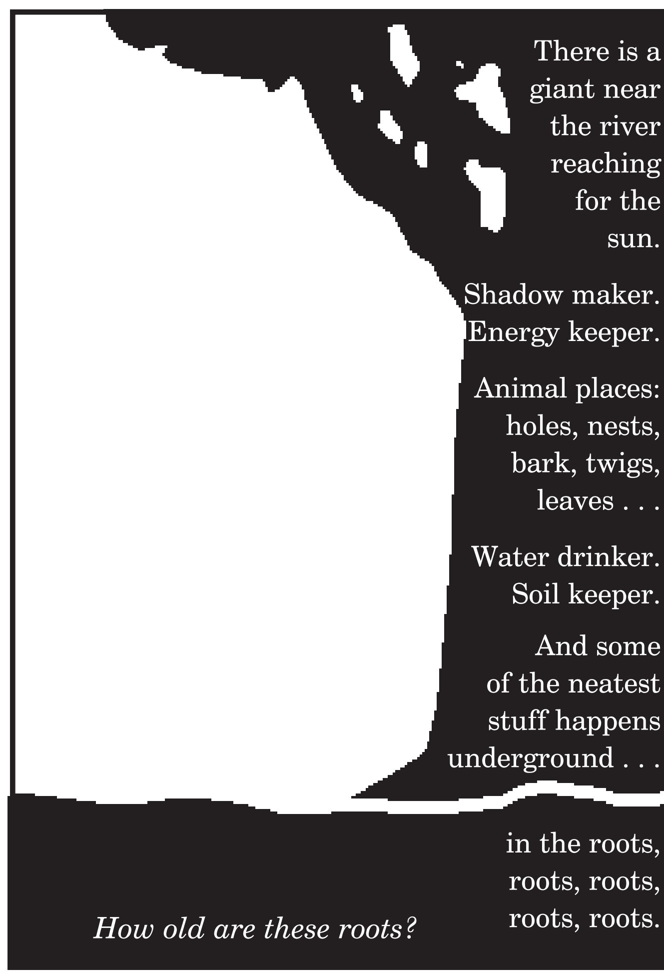
What can you find?

Can you find any sign of fire in these woods?

Most fires in the bosque are started by people. What do you think about that?

Every time I see some water, be it a ditch or drain, river or marsh, pond or puddle, I like to stop and look for mosquito fish. Tiny swimmers chomping up mosquito larvae. Go get 'em, guys, I urge them, but they don't even seem to know that I am there.

Pssst! Don't tell anyone, but there are really nifty bugs that live in the water. Get a white shallow plate, and put some river (ditch, marsh, pond) water and rocks and old leaves from the river in it. Wait a minute, and watch your aquarium come to life! Can you believe the way some of those critters can move? Don't forget to put them home again when you are done.



There is a giant near the river reaching for the sun.

Shadow maker. Energy keeper.

Animal places: holes, nests, bark, twigs, leaves . . .

Water drinker. Soil keeper.

And some of the neatest stuff happens underground . . .

in the roots, roots, roots, roots, roots.

How old are these roots?

How many lizards live in the bosque?

fast you are
but I spied you
darting for shade
and protection

Someone told me there would be no more cottonwoods for my grandchildren to see. Hmm, I thought, can that be true? And so I went to the bosque to see if I could find the baby cottonwood trees that could someday shade my children's children's children. And this is what I saw:

teach me your song, I asked the bird,
and the song went like this . . .

I went to the bosque today. I saw something special.

I've put a clue right here on this page. Maybe you can guess what I saw.

Maybe this clue will remind me of today's special event

years from now, when I am older and I am looking back at this book.

4. Naturalist Notebooks

Description: Students learn how to keep notes on their observations and activities in the bosque.

Objective: Students will develop essential observation and recording skills required of naturalists, scientists, or other nature appreciators.

Materials: naturalist activity pages
pencils
hard surface for writing, such as cardboard, notebook, or a clipboard
thermometer
compass
tape measure
field guides for reference back in the classroom

Background: In this chapter we have provided three examples of focused journaling activities. These activities introduce students to the process of collecting field information and teach them some basic journaling skills. All three activities follow the same format—introduction, general observations and site description, directed observation and/or data collection, and synthesis. This format encourages students to ask questions and continue their learning back in the classroom with field guides and other resources. Also see Activity #44, Naturalist Notebooks: Fire, in Chapter 6.

The **Rio Grande** activity focuses on the river and provides guidance on drawing the landscape. The **Cottonwood** activity involves basic data collection (students measure the diameter of a tree) and encourages students to focus in on one particular part of the tree. The **Birds of the Bosque** activity will help students to observe not just birds but the evidence that birds leave behind.

These journaling activities can stand alone, be used as an introduction to other activities in the guide, or be the beginning of a long-term journaling project. To extend this activity we have included "Guidelines for Keeping a Field Journal" after the following focused journaling pages. We hope this will inspire both you and your students to explore a number of other topics over time.

Extensions: Other journaling topics might include: exotic/invasive species, human impact on the bosque, mammals, decomposers, plants, arthropods, weather, leaves, ecosystems, animal evidence. Also, students could visit the same site several times over the course of the year and record the changes over time.

4. Naturalist Notebooks

Grades: 5–12

Time: 30 minutes to one hour

Subjects: science, language arts, visual arts

Terms: *cohort, keystone species, diamater at breast height (DBH)*

If you were to visit this same area in three months, do you think it will it have changed? Why?

What are some questions you have about the river? What else would you like to know about it? Write your questions here.

The Rio Grande

The Rio Grande flows 1,885 miles (3,016 km) from southern Colorado to the Gulf of Mexico, through three states in the U.S. and four states in Mexico. It sustains many plants and animals and is used by people for agriculture, hydropower, manufacturing, recreational, and domestic uses. Today you will make some observations about the river as it appears in your area.

Name

Date and time

Location description

Weather
(temperature, wind, cloud cover, precipitation in the last 24 hours)

Find a comfortable spot and spend at least five minutes observing the river. Use words to record your observations.

I see

I hear

I smell

I feel

- Draw a shape map of the landscape in the box above.
- Begin by drawing a line to represent the top of the trees, or mountains, or whatever meets the sky.
- Next, drop down to the bank on the other side of the river and sketch in where the water meets the land.
- Now sketch in the near bank on your side of the river.
- Using simple images, draw in the trees, seedlings, and sand bars or whatever you see in front of you.
- Label what you draw.

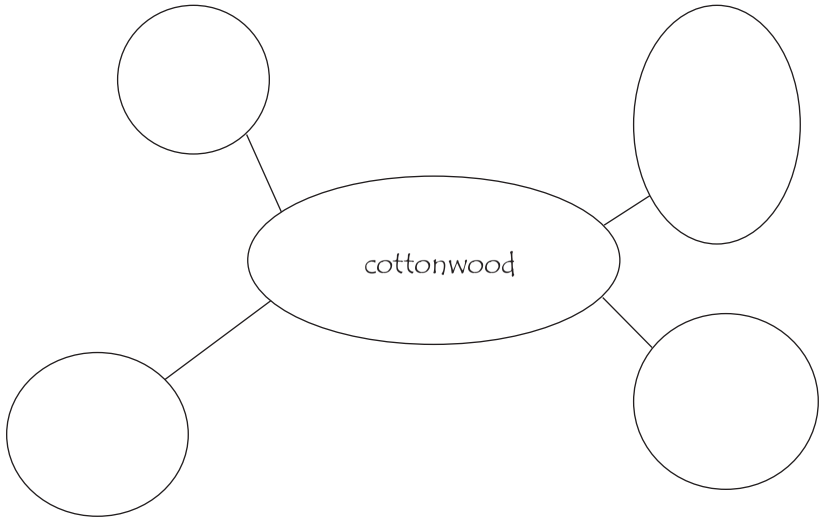
How high do you think the river needs to rise to flood over the banks? How high to flood where you are sitting?

If the river is not bank-full, take a walk along the river bed to see the exposed gravel, sand bars, clay and/or silt (collectively called sediment). Add these features to your landscape drawing. Make sure you also indicate the direction the river is flowing.

The size of particles along a stream can tell you about the flow of the river. Faster water can carry larger items including gravel; the water must be very still to create clay deposits. Describe the sediment in this area. Based on the size of particles you observe, does the river run relatively fast or relatively slow along your stretch?

TREE 4

As a keystone species, the Rio Grande cottonwood is connected to many elements of the bosque. Using the web below as a starting point, fill in the elements that are connected. You may add more elements or connections.



What are some questions you have about this tree? Anything you might want to know more about?

Rio Grande Cottonwood

TREE 1

The Rio Grande cottonwood is a keystone species in the bosque. The word "keystone" literally refers to the piece of a stone arch that locks the other pieces in place. Without a keystone, the arch would collapse. Without the cottonwoods, the bosque would cease to exist as we know it. Many animals use it for shelter or food. The health of the cottonwood forest is also a good indicator of the overall health of the bosque. Today you will take a close-up look at a cottonwood.

Name

Date and time

Location description

Weather

(temperature, wind, cloud cover, precipitation in the last 24 hours)

Find a cottonwood in the bosque. You will recognize it by its large size and triangular-shaped quaking leaves. Look at it very carefully for a least a few minutes. Make a contour drawing by drawing the whole tree without looking at your paper and without lifting your pencil from the paper.

Using words, make some observations about the tree. What does it look like? Feel like? Sound like? Does it remind you of anything? What other organisms do you see on or near the tree?

A cohort is a group of trees that are all the same age—they germinate during the same event—but they may not be the same size. Some trees may grow bigger because they have more space, get more nutrients, or have a genetic tendency to grow faster.

Wrapping your hands or arms (or one or more classmates' arms depending on the size of the tree) around the trunk, compare the different sizes of trees near your tree. This called "diamater at breast height," a way to compare sizes of trees. Do you think they are part of the same cohort?

Tree #	Size
1	
2	
3	
4	
5	
6	
7	

Pick one part of the tree to examine closely. It could be a leaf, a branch, or anything else that catches your interest. Sketch it or describe it with words.

Reflection

Based on your observations, why are the birds here? Give three possible reasons.

Write a riddle about one of the birds you have seen today. See if your friends and classmates can figure out from the riddle what bird you are describing. In writing your riddle think about the bird's behavior, where it lives, what it eats—do not just write a description.

Now that you have observed the birds and their behavior, what else do you want to know? Write down two questions you would like answered.

Birds of the Bosque

There are many different species of birds that live in the bosque. Some of the species are year-round residents; others spend only the summer or winter here. Still others only pass through as they migrate in the spring and fall. The goals today are to find as many species of birds as you can and to discover what they are doing and why they might be here. Remember, some of the birds are very secretive. You have the best chance of seeing birds if you are quiet.

Name

Date and time

Location description

Weather

(temperature, wind, cloud cover, precipitation in last 24 hours)

Before you begin, answer the following questions:

1. What birds do you expect to see?

2. What do you think the birds will be doing?

We are going to examine some of the different habitats in the bosque. Ornithologists (scientists who study birds) spend many hours sitting quietly, watching and listening to birds. Go to each area and sit quietly for at least five minutes. Look and listen not just for the birds themselves but also for evidence of the birds.

Along the River

Draw in detail one bird that you see in the area.

Describe what the bird is doing.

Where do you hear the birds in relation to you? Put marks in the box below to represent the birds. (You might want to use different marks to represent whether the birds are up high or at your level.)

you

In the Trees

Draw in detail one bird that you see in the area.

Describe what the bird is doing.

Evidence of Birds: Scientists often look for bird evidence as much as for birds themselves. Write or draw the evidence you have found:

food

nests

feather

droppings

tracks

calls

holes

Field Journal Guidelines

Naturalists keep field journals to record their observations and track their thinking about experiences in the outdoors. There are many ways to keep a field journal; methods vary depending on one's purposes. Here is one set of guidelines for keeping field notes in a "class" environment where notes will be turned in for grading and review.

Your assignment is to keep a field journal throughout our project. You are expected to maintain the index and to take notes in the field, during labs, on pertinent conversations, in class, and any other time you are working with things related to your field experience. The notes may be important to yourself or others many years down the line. You are expected to write your notes in the field or during the actual lab. Although you should try to be neat, field notes should not be perfect but rather reflect the conditions under which they were written.

Maintaining the Index

To help find information quickly in the future, it is important to dedicate the first few pages of your journal to indexing. (You may want to save the first page for a title page.) Make sure the journal has page numbers; if not, number the pages in the upper outside corner of each page. Each time you participate in an activity related to your study, make an entry in the index, which includes:

- page number(s) where you write your comments (drawings, etc.)
- your name or initials
- the date
- location (if applicable)
- a short description of what you were doing

Example: Page 32 mcs 9/17/99 Santa Ana BEMP Site, Bernalillo, NM, BEMP monthly collection

Taking Field Notes

Every time you go to the field, write notes. These notes should include:

- the date and day of the week
- your name and the names of your companions
- a brief description of the weather including the temperature (if you have no thermometer, use words like "chilly," "mild" or "hot"), cloud cover, any precipitation (rain, snow, hail, etc.), amount of wind
- a brief description of the location including the name of where you are and, if reasonable, travel directions so someone can find the site again
- notes about observations you have made (wildlife sighted, changes to the site, phenology of plants—such as cottonwood leaves are turning yellow on 25% of trees—etc.)
- notes about your work; explain what you are doing and why

You may also want to include:

- a sketch of something you have observed that you found interesting
- at least one question that you have thought of relating to your work in the bosque or relating to your understanding of the program
- natural history samples such as flat things like plant leaves or seeds which you tape into your notebook to aid with identification
- a map of where you are and what you are seeing

Taking Lab Notes

When you are no longer in the field, but working with materials collected in the field, such as water samples, or other kinds of data, this is considered lab work. Write notes while doing lab work to help:

- record pertinent data
- keep track of questions you have that you need to find answers to
- document any unusual observations
- record what day you are doing the work, what work you are doing, and who is working with you.
- include printouts of tables and graphs you generate from your data

Other Things to Include

Remember that other people will examine your field journal. Naturalists' field journals can be considered legal documents and have occasionally been used in legal cases. We hope this inspires you to do a good job of keeping notes, but remember we are all human and nobody keeps perfect field notes. Do the best job you can when you are in the field or the lab, and *do not wait to make your notebook entries* as a homework assignment to catch up on later—do them in the field or the lab.

Remember, your field journal is a written record. It documents the effort you put into a course of study and observation. From a legal perspective: if it is not recorded, it wasn't done. From a practical perspective: if you don't record something, you may forget about it later.

Be Sure to Include	Do NOT Include	Optional
all field notes with data	unprofessional remarks about other people	thoughts and personal insights on readings, class discussions, conversations with others
lab notes to document samples worked on, dates, problems, data, etc.	any other inappropriate information	notes on related lectures and programs
pertinent information from phone calls or conversations related to your field work	class notes	newspaper clippings and other information that relates to your field work
drawings and diagrams to help illustrate your observations		natural history notes, plant pieces, drawings, etc.
unlisted phone numbers		

5. Scavenger Hunt

Human Signs in the Bosque

Description: Students search for impacts of humans in the bosque by walking a bosque trail and using a scavenger hunt list to keep track of human signs.

Objectives: Students will:

- identify human signs in the bosque;
- understand impact of human activity in bosque; and
- evaluate their own actions while in the bosque.

Materials: Student Activity Sheet: Scavenger Hunt—Human Signs in the Bosque, one per student

pencil

optional: field journal

Background: The bosque reflects the many activities of homesteaders, visitors, developers and agencies, which alter bosque plant and animal communities and the hydrological system. Every activity has results, some of which we are just beginning to see. Some of these activities are beneficial, while many others produce long-term detrimental effects.

Russian olive leaves

Russian olive and saltcedar or tamarisk trees were originally planted along riverbanks during the reclamation projects. They were to serve as windbreaks and to hold soil in place when the river flooded. They have now become "naturalized," meaning they reproduce and spread on their own.

5. Scavenger Hunt—Human Signs in the Bosque

Grades: 3–8

Time: material preparation: 10 minutes

class activity: one hour

Subjects: science, social studies

Terms: *sign, scat, trash, salt deposit, domestic, tree carving, graffiti, vandalism, detrimental, exotic, naturalized, acequia*

Other exotic plants such as elm, mulberry, pampas grass and juniper were transported to the bosque in beds of pick-up trucks. People used to dump yard waste there after cleaning their yards and pruning trees.

Salt deposits, a white crusty substance on the surface of the ground, occurs when water evaporates and the salt that the water contained is left behind. Where does the salt come from? It is within the soil deposited there from the river or from salt-concentrating plants such as tamarisk (also called saltcedar).

Exotic animals have also been introduced. Starlings were brought to America in 1890 by the American Acclimatization Society who wanted to establish all of the birds mentioned in Shakespeare's works into the Shakespeare Garden in New York City's Central Park. The house sparrow (English sparrow) was introduced to New York City in 1852 or 1853 and by 1900 was one of the most abundant birds in North America. Since their introductions, both starlings and house sparrows have spread across the United States, including the Middle Rio Grande Valley.

Jetty jacks were also placed in the riverbed and along the riverbank to slow the floodwater and protect the levees. Some of these jetty jacks are now buried in river sand or submerged in the river.

Feral dogs and cats have been abandoned in the bosque by people no longer wanting them as pets. Also abandoned are the domestic ducks, rabbits, and chickens often given to children at Easter. When the animals have lost their appeal they are abandoned here.

Sawn logs tell of a woodcutter, someone seeking firewood or building material for their home.

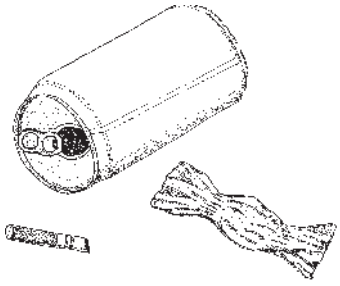
Burned logs indicate a fire. Lightning causes a very small percentage of bosque fires, about 2% according to one study. Smoking, weed burning, fireworks and arson are the most common causes of bosque fires.

Tagging and graffiti became a sport of dare in recent years, as have paint guns.

Birdhouses have been installed to attract owls, woodpeckers, wrens, chickadees and some bats.

A sneaker print or bike track is a record of your visit to the bosque. The paved bike trails are part of Albuquerque's bike trail system. Sadly, some bike riders want to experience the thrill of riding in the sand and ducking in and out of the cottonwood trees, churning the soil and uprooting plants.

Trash: The bosque has a long history of being used as a dumping ground. Tons of garbage were removed from the bosque including old household appliances, car bodies, trees, broken-up concrete from sidewalks and streets, stumps and logs from cut trees. Some of this rubbish remains. Present-day trash consists of cigarette butts, candy wrappers, honey sticks, and tissues. Beer and soft drink cans, glass and plastic bottles and dog poop show a lesser degree of care. Plastic bags used by hikers or picnickers blow away and land in trees, stuck forever, as they become tattered flags of human disrespect for natural areas. Some people carve their names and dates in trees, opening the tree's protective bark to disease and insects.



Floating debris in the river itself: Plastic and aluminum containers, pieces of Styrofoam coolers, plastic six-pack rings, and tires are seen. Motor oil is washed from city streets into the storm drains that discharge into the river. Some people dump their used motor oil directly into city drains causing a detrimental effect on the plants and animals of the river community.

Procedure:

1. Just like finding signs of wildlife in the bosque, students are to look for evidence of human activity in the bosque.
2. Explain that since the time of indigenous people of North America and as the Spanish began to settle along the Rio Grande, people have made changes to the bosque. Some changes were to trap floodwater or dig acequias to divert river water to irrigate crops. All of these manipulations have impacted the ecological system. In the last 100 years large-scale changes have altered the river. Introduced plants and animals, roads, levees and jetty jacks, irrigation systems, homes, farms and recreational activities have altered the natural flow of the river.

3. Question students about how their activities during a field trip in the bosque may also cause changes. Dropping trash or trampling plants are two effects. Reseeding native grasses, clearing deadwood or installing nesting boxes are others.
4 Distribute student activity sheet "Scavenger Hunt: Human Signs in the Bosque."
5. Have students circle or draw the signs of human activity as they find them on their walk. Have students add other things they see that are not on the list.

Assessment: Discuss the impact of the human signs.

1. What human activity caused this sign?
2. Was this item introduced, released, placed here or planted for a purpose? What was that purpose?
3. What other signs of human influence can you find?
4. How many of the signs you have found result from intentional vandalism?
5. How many signs are unintentional results of other actions?

Extensions: Have students carry a litterbag on their walk.

Have students plan and carry out a service-learning project (see Chapter 7).

Back in the classroom, have students draw a human impact bosque scene and a scene as it might be without human impact.

Scavenger Hunt

Human Signs in the Bosque

Sometimes the only proof of animals in the bosque is the sign they leave which tells of their activities. A feather from a preening bird falls to the ground; scratches in the soil mark the hole of a hiding mouse. Perhaps scat on the trail tells the story of a night's hunt. Tracks in mud record the passage of those who came to drink. Humans also leave signs of their activities. As you walk the trail, check your list for signs of human activity.

Russian olive	jetty jacks	starling
saltcedar	salt deposit on ground	dog
elm	sawn log	domestic duck
mulberry	burned log	graffiti
pampas grass	bird house	sneaker print
trash	trail	bike track
carving in tree bark	floating trash	plastic in tree

Discuss the human signs noticed.

What human activity caused this sign?

Was this item introduced, released, placed or planted for a purpose?

Was the introduced item useful or harmful?

What other signs of human influence can you find?

How many of the signs you've found are the result of intentional vandalism?

How many signs are unintentional results of other actions?

6. Wildlife Detectives

Description: Students look for signs of wildlife living in the area.

Objectives: Students will:

- find out what wildlife is living in the bosque;
- examine habitat needs of different wildlife species; and
- use observation skills.

Materials: paper/journals

pencils

natural history guides (tracks, scat); see Appendix B: Annotated References

Procedure: Set clear boundaries for the activity. Define the area for the activity. It can be "stay between this path and the river" or "within ten paces of this path" or whatever is appropriate. Many areas in the bosque look alike and if separated from the group, students can get disoriented and feel lost. Clearly mark a dividing line so that the area is divided into two equal halves.

Divide class into six groups. Assign each group one of the following categories.

Tracks I	Tracks II
Scat & Bones I	Scat & Bones II
Homes I	Homes II

Assign Groups I to one-half of the area and Groups II to the other half of the area.

Students should look carefully throughout the area for their assigned objects. Stay within marked boundaries. Record observations only; do not collect evidence. Look first; never put your hands, feet, or face where you have not looked. Have students use natural history guides to identify their finds, if possible. Encourage

6. *Wildlife Detectives*

Grades: 3–8

Time: 30 to 60 minutes, depending on student interest levels

Subject: science

Terms: *tracks, scat*

students to draw pictures of their finds and keep a tally (i.e., number of small bird tracks, coyote tracks, etc.). If time permits, allow students to switch categories and look for something new.

At the end of the allotted time, bring students together and compile findings. Use the following questions to lead a discussion of their findings.

How many different types of animals live here?

How many of each animal might live here? How do we know?

How many of these animals live underground? In the trees? On the ground?

Where do each of these animals find water?

How do each of these animals find food?

What types of homes do each of these animals need?

Assessment: Have students write about their findings, either in a field journal or as an assignment. Answer appropriate discussion questions as well.

Extension: On paper construct a food web using the animals listed.

7. Crawly Creatures

Description: Students look for insects, spiders, and other arthropods. The survey leads into examination of habitats.

Objectives: Students will:

- discover what insects, spiders, and other arthropods live in the bosque; and
- learn the differences between insects, spiders, and other arthropods, some of their natural history, how they benefit the bosque ecosystem and the habitat in which they are found.

Materials:

1. bug boxes—one for every three students; small box with magnifier top is best, but any small clear vial or jar with a cover and a magnifying lens will work.
2. insect nets (optional)
3. extra small jars
4. home-made Berlese funnel (large funnel with coarse screen material covering the narrow opening) and bucket to set the funnel on (optional)
5. insect guides—one for instructor; use student pages in "Pitfall Trapping" activity and/or Appendix E: Arthropods
6. paper and markers

Procedures:

1. Review Appendix E: Arthropods in this book for an overview of the insects, spiders and other arthropods that live in the Rio Grande bosque before doing this activity.
2. Define the area for the activity. It can be "stay between this path and the river" or "within ten paces of this path" or whatever is appropriate. Many areas in the bosque look alike and if separated from the group, students can get disoriented and feel lost.

7. Crawly Creatures

Grades: K–8

Time: approximately 45 minutes

Subject: science

Terms: *arthropod, habitat, Berlese funnel*

3. Explain how to use the equipment.
   a. Bug boxes: Spot an insect on the ground or a plant, carefully encourage it to go in the box and quickly put the cover on. Look at it with a magnifying lens. Pass it around for other students to see. Return it to the area where it was caught.
   b. Insect nets: Students sweep through plants or grasses; then tip the rim of the net sideways or up-side down so the rim closes the net; and look at what they have caught. They can ease a jar and cover into the net, to capture some of the bugs and get a better look at them. Always return the insects to the place where they were caught. Insect nets must be returned free of any debris. Sometimes the sweep collects mostly grass seeds, so students must take the time to clean the net.
   c. Berlese (pronounced burr-LAY-see) funnel (one set-up for the whole class): Get a large funnel and put a piece of screen across the bottom to cover the hole. Set the funnel in a bucket or large can, so the tip of the funnel is not touching the bottom of the bucket. Get a handful of leaves and other soil-surface material and place in the top of the funnel. You can set the bucket with the funnel in it under a bright lamp and wait a day or, alternatively, you can shake the funnel and bucket together. After a while, there should be crawly creatures in the bottom of the bucket. You have to look carefully; some are almost microscopic!
4. Briefly discuss the difference between insects, spiders, centipedes millipedes. See "Pitfall Trapping" and/or Appendix E.
5. Divide the class into groups of three. Provide each group with two or three bug boxes and one piece of collecting equipment. Use these other collecting tips: look under rocks or wood, roll the rock towards you; this reduces the chance of getting bitten by something hiding underneath—it will strike toward the opening, which is away from you. Always return the rock to the same resting spot. Why? Animal homes are underneath. Do not collect wasps, bees, or black widow spiders; all can give a painful sting or bite and some students may be allergic to them. It is best not to handle critters with your hands. Emphasize putting things back where they were found and treading lightly on the ecosystem.
6. Let students explore for at least 15 minutes. Wander among groups to help them identify their finds.
7. Call the groups together in a large circle. Have the students pass their bug boxes around the circle so everyone gets a chance to see what was caught. On a piece of paper, make a list of the

critters collected. Provide interesting tidbits of natural history related to the creatures collected.

8. Introduce the concept of habitat (the arrangement of food, water, shelter or cover and space suitable to animals' needs). You are in a riparian habitat, but each critter will have its own particular mini-habitat. Have students describe the specific habitat for each of the types of critters caught, i.e., grass, large tree, leaves on the ground, etc. On the paper draw a chart with the categories of habitat at the top and list the insects found at each habitat at the bottom.
9. Discuss what contributions insects make to the ecosystem (food chain, soil aerators, seed planters, pollinators etc.). Discuss what contributions insects, spiders, and other arthropods make to humans (seed planters, pest control, food producers).
10. After the discussions, have students release their catches in the same place they were found.

Extensions: Use the cards in NatureScope Incredible Insects Discovery Pac to look at some of the cool characteristics of insects.

Use the microscopes to look at some of the insects back at school.

Reference: NatureScope Incredible Insects Discovery Pac. 1988. National Wildlife Federation, Washington, D.C.

8. Pitfall Trapping

Description: Students set out pitfall traps to collect and identify arthropods, releasing animals to their original trapped areas once they are counted and identified.

Objectives:
- to sample surface-active arthropod populations in the bosque;
- to examine and identify different types of arthropods; and
- to use observation skills.

Materials: Pitfall installation materials:

eight plastic cups, 16-ounce (473 ml) size. (Solo brand P-16 cups work fine)

eight plastic cups, 16-ounce size, with a hole popped in the bottom of each cup with a 16-penny nail or like object

meter tape or measuring stick (optional)

permanent marker (optional)

hand trowels

compass (optional)

eight pitfall trap covers (optional). Materials:

exterior, 3″ (7.5 cm) wood screws

eight pieces of $^{3}/_{8}$″ (1 cm) thick exterior grade plywood cut into 6″x6″ (15x15 cm) pieces. (A 4′x8′ sheet of plywood yields 128 6″x6″ squares.)

enough exterior-grade paint to cover the plywood

8. Pitfall Trapping

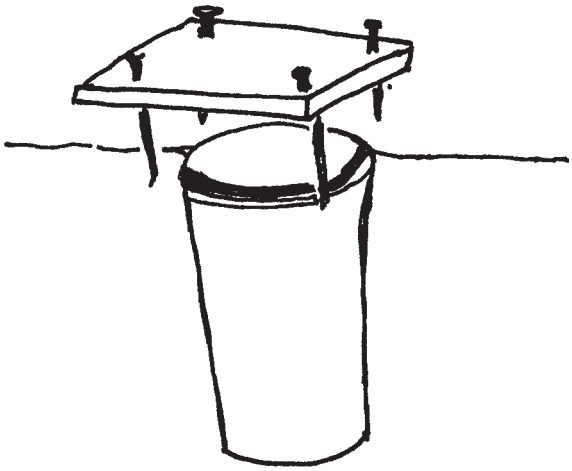
Grades: 4–12

Time: One or two 30-minute classroom planning sessions; one hour to set up traps; 30 minutes to collect arthropods; 30 minutes to one hour to identify and count arthropods; one or two 30-minute classroom sessions to examine results, state conclusions, draw inferences, and make recommendations. Pitfall trap monitoring is a two-day task. Traps are opened on Day 1; trap contents are collected 48 hours later.

Subjects: science

Terms: *arthropod, population, habitat, invertebrate, vertebrate, inter dependence*

Pitfall trap cover construction details: A completed pitfall trap cover looks like a small table. It should be assembled and painted prior to going into the field. Or for less sturdy or permanent trap covers, substitute cardboard for the plywood. Cardboard lids will not withstand weathering or intense rainfall, but are generally suitable for one trapping period (two days).



Day 1 supplies:

log book and pen to record data

all materials for installation

Day 2 supplies:

one to eight plastic one-quart self-sealing plastic bags

marker to record on bags

insect identification charts or field guides

small blunt tweezers (optional)

log book and pen to record data

plastic wrap (optional)

eight rubber bands (optional)

Background: Schoolyards, wetlands, fields, woodlands, and other outdoor areas are homes for a host of small animals—insects, spiders, centipedes, etc.—that you rarely see. These invertebrates are called surface-active arthropods. They provide information about habitat conditions. The presence, absence, abundance, and diversity of particular arthropods can provide a wide array of information about forest conditions. A pitfall trap can be used to capture these small creatures so you can examine their numbers and varieties. Pitfall traps are used for sampling animal populations by:

(a) capturing species which are difficult to obtain by other methods;

(b) estimating relative abundances and species richness or for catching particular types of animals; and

(c) determining movement patterns of individual animals.

The pitfall trap is a relative method of estimating animal numbers and species, thus it cannot be used to estimate absolute population sizes or overall species richness of an area. It produces an "index" by which several areas can be compared. It is a "passive" form of sampling which relies on the animal rather than the observer making the action that leads to capture and enumeration.

Procedure: If traps will be used from year to year, permanent pitfall trap covers should be installed. To make them:

1. Drill one wood screw into each corner of each plywood piece. The screws should be about a half-inch in from the corner sides. The screw head should be nearly flush with the top of the plywood.
2. Paint both sides and all edges of the cover. Use the paint to seal around the wood screws and the board.
3. Allow covers to dry.

Pitfall installation directions:

1. Locate pitfall and select a site to place the pitfall trap.
2. Using a hand trowel, dig a hole about 6" (15 cm) deep.
3. Stack an intact cup (one without a hole in its bottom) on top of a cup with a hole in its bottom. The bottom cup maintains the form of the hole and has a drain hole in its bottom. The top cup is the trap cup and must remain intact without any holes or cracks. Place the stacked cups in the hole that was just dug.
4. The trap should be set so that the rim of the top cup is level with the ground surface. The rim of the top cup should be neither above nor below ground surface.
5. Backfill the hole around the two cups with soil. Using materials from the immediate area restore the surface debris around the trap to a state that matches the site's previous condition.
6. Leaving the bottom cup in place, gently remove the top cup and dump out any debris that fell into the trap when it was being installed. Reset the top cup in the bottom cup.

7 Using the permanent marker, record on the underside of the trap cover the trap number and its location. Number the traps from 1 to 8.

8. Place pitfall trap cover over trap. To close the trap lid, push the lid down so that it is flush with the rim of the top cup. This

should prevent creatures from getting into the trap while it is closed. (To open the trap, follow the directions outlined in the "setting and collecting procedure" below.)

9. Move to the next trap site and repeat Steps 1 through 8. Traps can be set in systematic arrays or randomly. For systematic sets measure a known distance, such as 33 feet (10 meters) in a square or 33 feet apart along a line. Setting up two sets of traps in two different locations will allow for comparisons between sites. If plywood trap lids are used, traps can be left in place and set for occasional trapping so students can compare results through the school year or in different weather conditions.

Setting and collecting procedure:

Day 1

1. Each trap consists of two cups and a cover. The top cup should be intact and free of holes and cracks. The bottom cup should have a small hole punched in the bottom to drain water. When setting a trap that has already been installed, remove the cover by opening it away from yourself. (This way if something is in the trap you are not expecting, it is less likely to come toward you.) Lift out the top cup, but leave the bottom cup in place to hold the form of the hole. You may need to hold the rim of the bottom cup as you pull the top cup out. Clean out the top cup. Scatter any contents and debris. Leaving the bottom cup in place remove any dirt that might have fallen into it. Replace the top cup into the bottom cup.
2. Confirm that the cup is level. The rim of the top cup should be level with the ground surface. If it is not level, take out both cups, redig the hole and replace the cups so that they are at the right level. This is important for accurate trapping.
3. The lid, designed to reduce predation and limit rainfall, should be lifted about 3 to 4 cm (1.5 inches) above the cup rim. Once it is set you should be able to slide two fingers between the cup and the cover. Record in the logbook when the trap was set.

Day 2 (48 hours later)

4. Remove the cover by opening it away from yourself. Lift out the top cup, but leave the bottom cup in place to hold the form of the hole.
5. Empty the entire contents (bugs, leaves, dirt, etc.) of each trap into a plastic bag. Record in log book or report form when the trap was emptied. If you find an empty trap, record that finding in your logbook.

6. Examine the contents of the trap carefully and make notes on the quantity and type of arthropods. You can use the key provided to identify some common surface active arthropods found in the bosque. For animals you cannot identify, include a description. Magnifying glasses and identification books can also help you identify the captured animals. If you are concerned about what has been captured, you may want to make your observations without opening the plastic bag. NOTE: This may reduce the accuracy of your count so do it carefully.
7. If a vertebrate species has been caught, do not handle it (there can be a health risk). Record the animal type and release it. If you catch shrews, which rarely happens, they will most likely be dead. Place them away from the study area out of reach.
8. After identifying and examining (or drawing) any arthropods, release them in the same vicinity where they were captured.
9. Remove trap completely from ground and leave the area as it looked before you dug the traps. Pack out all materials. If the traps are going to be used again, close them. Put the top cup into the bottom cup. Place a piece of plastic wrap or a cup lid over the cup and secure it with a rubber band. Close the trap lid so that it is flush with the rim of the top cup. This should prevent creatures from getting into the trap. To reduce the potential for disturbance the trap lid can be covered with leaves and dirt, but if you do this, place an upright stick or pin flag next to the trap to mark the location.
10. Create a data table to display your results.

Assessment: What types of animals did you find in the traps? Did the outside temperature have any impact on the number of animals caught? What types of animals may not enter a pitfall trap and what types might easily escape from one? Would you expect to find the same animals in the traps all year round? How could you test your predictions experimentally? This should become a team exercise. Each group might develop and write a hypothesis, list the materials they would use, the number of each item, and a procedure. An excellent way to assess this activity is to have the teams check another team's work to see if they achieve the same results. This will also replicate the real-world challenges facing a research scientist.

Extension: Set up traps in your schoolyard.

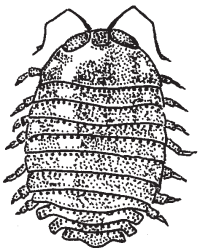
Have students pick one of the species captured and learn more about it. Write a report or present findings to the class.

Resource/ Reference: Bosque Ecosystem Monitoring Program Manual

Pitfall Arthropods

Here are drawings (not to scale) and descriptions of some common surface-active arthropods encountered in pitfall traps in the Rio Grande bosque. (Specialized terms and species names in *italics*. Artists: B=Bosque School student; M=New Mexico Museum of Natural History & Science; E= Ernie Pyle Middle School student)

sow bug
ROLAND SHAW (B)

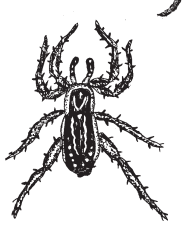


pillbug
CLAIRE EBERT (B)

Class: Crustacea
Order: Isopoda.....pillbugs or roly polys and sow bugs or woodlice

While most isopods are marine some, such as the widely distributed pillbugs ("roly polys") and sow bugs (woodlice), are terrestrial. All have somewhat flattened and multi-segmented bodies. Actually, none are either bugs or lice. Terrestrial isopods have 14 legs used for walking and crawling. In the bosque there are two species: a pillbug *(Armadillidium vulgare)* that rolls into a ball when stressed and a sow bug *(Porcellio laevis)* that cannot. Both species, like nearly all of their relatives, are scavengers and require moist habitats.

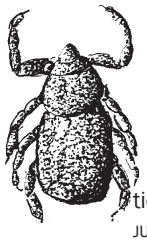
black widow spider
WILL COUTRET (B)



spider
LAURA ROSENBERG (B)

Class: Arachnida
Order: Araneae.....spiders

Spiders and other arachnids have two obvious body sections: a *cephalothorax* or *prosoma* (consisting of a segmentally fused area with anterior mouthparts [*chelicerae*] and eight legs behind them) and a clearly segmented abdomen or *opisthoma* that in spiders bears silk-spinning s*pinnerets* on the underside. Arachnids have a pair of appendages on either side of the mouth called *pedipalps*; in male spiders these act as copulatory organs. Spiders are predators of other arthropods, which they pierce with their chelicerae. They externally digest their prey into a liquid state, then suck out the tissues. Spiders and other arachnids come in many body styles, sizes, and colors.

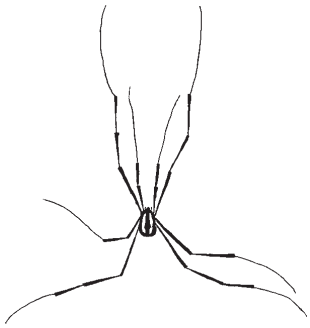


tick
JUSTIN HERTEL (B)

tick
AVIANNA MECK (B)

Order: Acarina.....ticks and mites

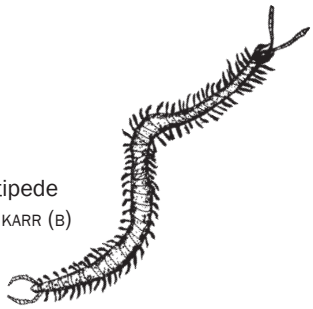
With eight-legged adults and what appears superficially as a single body unit, mites and ticks range in size from tiny to as large a human fingertip. Many are parasites of animals and plants. Many others are predators, especially of other arthropods, or are scavengers. Many mites found in bosque pitfall traps are brown or nearly white, while some are bright red. It is no exaggeration to say that mites are almost everywhere.



daddy-long-legs
TRAVIS LAY (B)

Order: Opiliones.....harvestmen or daddy-long-legs

Most people recognize daddy-long-legs by their eight long legs, which except for their apparently unsegmented body make them resemble *pholcid* spiders (which also show up in our pitfall traps). Most harvestmen are predators; however, some are scavengers.



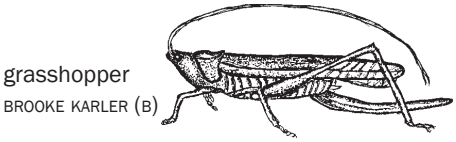
centipede
EVAN KARR (B)

Class: Chilopoda.....centipedes
Centipedes are flattened and have many body segments, each with one pair of legs. They are usually brown, tan, or yellowish. The head bears *antennae*, and just behind and to the side of the head is a pair of poison fangs. Occasionally one finds small brown *lithobiomorph* centipedes in bosque pitfall traps. The large local *scolopendromorph* species in the bosque is *Scolopendra polymorpha*. Like other centipedes, it is mainly a predator of other arthropods. Handle it carefully: it moves very fast and has a painful bite.

millipede
JAY KORY JOHNSON (B)

Class: Diplopoda .....millipedes
Millipedes are not very common in bosque pitfall traps. Unlike centipedes, they have two pairs of legs per rounded body segment. They move slowly and smoothly, using their short antennae to sense to check for environmental information. Millipedes eat mainly dead vegetation and are not poisonous, but many species secrete foul-smelling chemicals from abdominal glands.

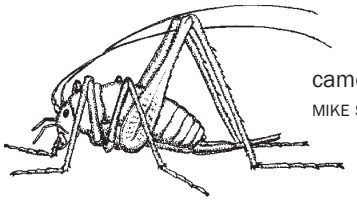
Class: Insecta
Order: Orthoptera .....grasshoppers, crickets and other groups
Although common in the bosque, grasshoppers are only occasionally found in pitfall traps. Adults of these and most insects bear six legs and a pair of wings on the *thorax,* which is behind the *head* and in front of the *abdomen*. The often colorful hind wings are held lengthwise along the back and are covered by the more drab and leathery front wings. Grasshoppers themselves are of many colors—including brown, tan, yellow, and green—that can match background colors. Grasshoppers are essentially *herbivore*s and chew plant material with their strong mandibles.
Crickets and their close relatives are mostly nocturnal scavengers. The common field cricket is black in color with large hind legs and long antennae. The brownish tan or gray camel crickets have long, curved antennae and an arched back. They often hide under logs and stones or in dark moist places. The Jerusalem cricket, or child of the earth, has a large head with powerful jaws that can cut plant roots and unwary fingers. Its antennae are short. The rest of its body other than its tan legs is pale yellowish with dark stripes. It spends much of its day in loose soil.



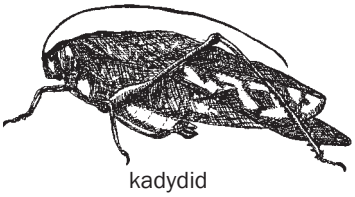
grasshopper
BROOKE KARLER (B)

field cricket
KENDRA CROWLEY (B)

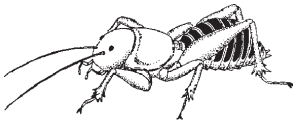
field cricket
JUSTIN STEWART (B)



camel cricket
MIKE SANCHEZ (M)

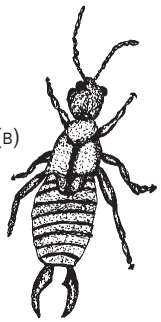


kadydid
KATIE SHAW (B)



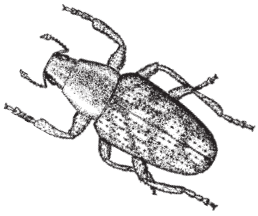
jerusalem cricket
MIKE SANCHEZ (M)

earwig
MAX STRASBURGER (B)



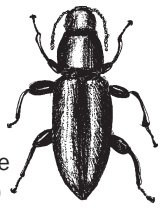
Order: Dermaptera .....earwigs
Earwigs are identified by their scissors-like pincers (*cerci*) at the tip of the abdomen. Their back wings are folded under very short, hard front wings. Their elongate, rather flat bodies are generally light brown to black in color. Although they do not bite or sting, these mainly scavenging insects can pinch. But they don't get into people's ears, as their name would suggest.

weevil
HELEN HASKELL (M)



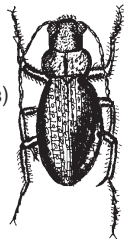
weevil
MIKE SANCHEZ (M)

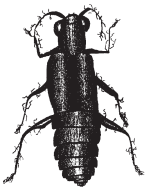
Order: *Coleoptera* .....beetles
Beetles, which make up the most species-rich order of animals on earth, are extremely diverse structurally. However, like the orthopterans and earwigs, they have chewing mouthparts, which in the plant-feeding weevils (curculionids) are located at the end of a sometimes long proboscis or beak. The hard front wings (*elytra*) of beetles cover the hind wings and abdomen. The generally predaceous ground beetles (carabids) tend to be indicators of relatively moist environments. In contrast, the darkling beetles (tenebrionids) are often found in drier environments. The rove beetles (staphylinids), which range from medium size to quite small, have short elytra that resemble the short front wings of the unrelated earwigs. However, unlike earwigs, rove beetles do not have prominent cerci at the tip of the abdomen. They are mainly predators, not scavengers. Species of these beetle families showing up in bosque pitfall traps are often dark in coloration.



darkling beetle
CAROLYN BARR (B)

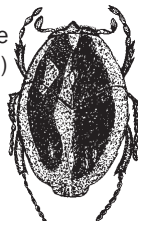
ground beetle
JAREN TROST (B)

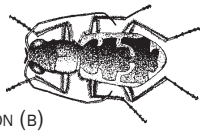




rove beetles
MARIO DELGADO (E)

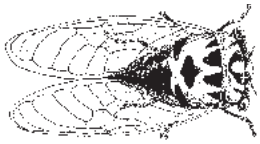
scarab beetle
ANNA RYBURN (B)



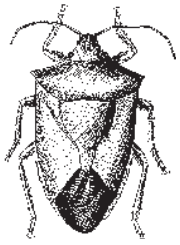


tiger beetle
MAX RICHARDSON (B)

cicada



Order: *Homoptera*.....leafhoppers, aphids, cicadas and other groups
Homopterans and the next order, Hemipterans, have sucking mouthparts and are highly variable in body shape and size. The front wings of homopterans are uniform in texture and tend to cover the back like a roof.

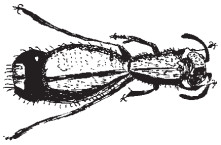


stink bug
HELEN HASKELL (M)

assassin bug
HELEN HASKELL (M)

Mostly plant feeders, these insects keep their short beaks between their front legs when not in use.
Order: *Hemiptera*.....true bugs
True bugs are have front wings that are relatively thick at the base and membranous at the tip. (The name *Hemiptera* means "half-wing.") Their feeding habits are highly variable, but most are plant feeders. Stink bugs and squash bugs are among a range of bugs found in bosque pitfall traps.

velvet ant
JIMMY SCANTLIN (B)



ant
MARIA SOCHA (B)

ant
ANNA HEINTZMAN (B)

Order: *Hymenoptera*.....wasps, bees and ants
Even though some wasps and bees live in the ground, they are rarely found in pitfall traps because they can fly out. The most common hymenopterans by far in the traps are ants, which have important and diverse ecological roles worldwide. So-called velvet ants, which are really wasps and can like many ants deliver a painful sting, are sometimes found in pitfall traps as well. They

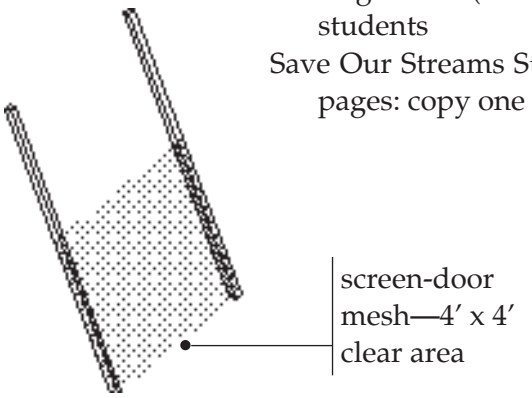
9. Kick-net Kritters

Description: Students collect and identify aquatic insects in ditches, drains,and low-flowing sections of the river. Teams of students kick the bottom of the channel upstream from a net which catches dislodged insects. Students use information on the kinds of insects they find to make general statements about the quality of the water they are sampling.

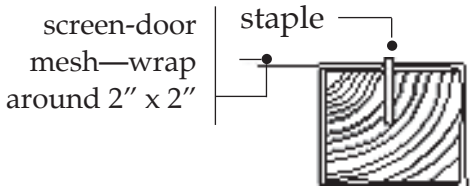
Objective: Students learn:

- that aquatic life found in a water body can indicate water quality conditions; and
- to identify aquatic insects from pictures.

Materials: For each kick-net:
two 2″ x 2″ x 4′ (5 cm x 5 cm x 1.2 m) boards for handles
screen-door mesh, metal or nylon, about 4′ x 3′ (1.2 m x 1 m) or 4′ x 4′ (1.2m x 1.2 m)
staple gun with staples
tweezers: one set per two students
white examining pans: one pan per three or four students
wading shoes (fishing waders or old shoes) for at least four students
Save Our Streams Stream Insects and Crustaceans identification pages: copy one set per two to four students



Kick-net



End Section of 2″ x 2″

9. Kick-net Kritters

Grades: 5–12

Time: 20 minutes for kick-net construction
45–60 minutes for kick-net collecting and identifying

Subject: science

Terms: *sediments, pollution, aquatic macroinvertebrate, organic material*

Background: Measuring water quality parameters like pH or dissolved oxygen is essentially like taking a "blood test" of the river. Water quality parameters tell us how "healthy" the river and its surrounding ecosystem are. Getting accurate measurements of water quality parameters is difficult, often involving expensive equipment and complex procedures. Another way to gauge the water quality in a waterway is to sample the aquatic life there. Water sample analysis describes conditions at one point in time for the waterway; the creatures found in the water reflect its long-term condition.

Scurrying along the surface, under rocks and across the bottoms of virtually every stream, river, ditch, or pond in New Mexico are a myriad of small insects and other invertebrates. These organisms are collectively known as "aquatic macroinvertebrates" because they are animals with exoskeletons who live in the water and can be seen without the use of microscopes.

To understand these animals, focus on their roles in the ecosystem, especially what and how they eat. In streams and rivers, there is a constant input of leaves, twigs, and other organic materials from surrounding vegetation. Aquatic macro-invertebrates thrive on this detritus, or dead plant material. Some animals, known as collectors, trap bits of organic matter such as leaf fragments, bacteria and other animal wastes upon which they feed. Some collectors are filter feeders like clams or blackfly larvae. Other collectors are scavengers like mayfly and caddisfly larvae and midges. Shredders cut up and eat leaves, aquatic plants and other larger materials. Some stonefly and caddisfly larvae, sowbugs and scuds feed in this manner. On rocks in rivers you can find scrapers. These insects hold on, despite powerful currents, to graze on algae attached to stones and other surfaces. Many of these organisms are flat to help them avoid being pulled downstream. Scrapers include water pennies, limpets and snails, midge larvae and certain mayfly larvae. All of these invertebrates fend off predators such as the dobsonfly larvae, dragonfly larvae or fish.

Some aquatic macroinvertebrates can tolerate high levels of sediments and other pollution. Other aquatic creatures are quite intolerant to low levels of pollution. By collecting and identifying what aquatic life is present in the water, we can make some inferences on the quality of the habitat for that area.

The variety of insects present in a waterway varies with the depth, bottom materials, flow rate and other environmental factors. Many aquatic macroinvertebrates that live in "high quality" waters are found in small, clear mountain streams, and we would not expect to find them in the Middle Rio Grande, even before major human alterations. A valuable approach to interpreting aquatic macroin-

vertebrate studies on water bodies in the bosque is to compare results with various sampling sites and at various sampling times.

In order to compare results between sites, dates or groups of students, the method for collecting insects must be standardized. The following procedures outline the method used by many scientists, including middle school and high school students in New Mexico and Colorado who are active in year-round monitoring programs. If your class follows these directions, they can compare their results with other classes' findings.

Procedures:

1. Prior to going to the field, make the kick-nets. Staple the mesh screening to board. Each kick-net should be 1 meter (39.3 inches) wide, with a board (for a handle) on either end.
2. Select the sites to sample. You may wish to sample the river, a ditch, and a pond. Within a waterway you may sample different habitats such as near a sand bar, in a riffle area, and in a backwater pool.

SAFETY CONCERNS: Avoid quicksand. Never have students sample in water that is deeper than their knees.

3. Have two students stand in the water, stretching the kick-net between them. The bottom of the kick-net should be flush with the bottom of the river channel.
4. Have two other students kick the bottom of the channel upstream from the net for three minutes. If rocks are present, turn them over. The river may be stirred with a stick.
5. Remove the kick-net from the water and pick off insects for 30 person-minutes. Use tweezers to remove visible animals from the net. Place all collected specimens in the examining trays. If one person is collecting, they would continue for 30 minutes. If six students are collecting, they would remove insects from the kick-net for five minutes each.
6. Return any remaining material on the kicknet to the river to avoid detaining any "uncollected specimens."
7. Examine insects or other invertebrates in the trays.
8. Identify what you can from Save Our Streams card, and record the numbers of each type of animal you find. Record any animals you cannot identify as "unknown."
9. After invertebrates are identified and recorded, return them to the location where they were collected.
10. Repeat this procedure for other sampling locations.

11. Have students compare any differences in their collections between sites. Point out that the groups of insects on the Save Our Streams cards are listed by tolerance to pollution. What groups of insects are represented in the students' data?

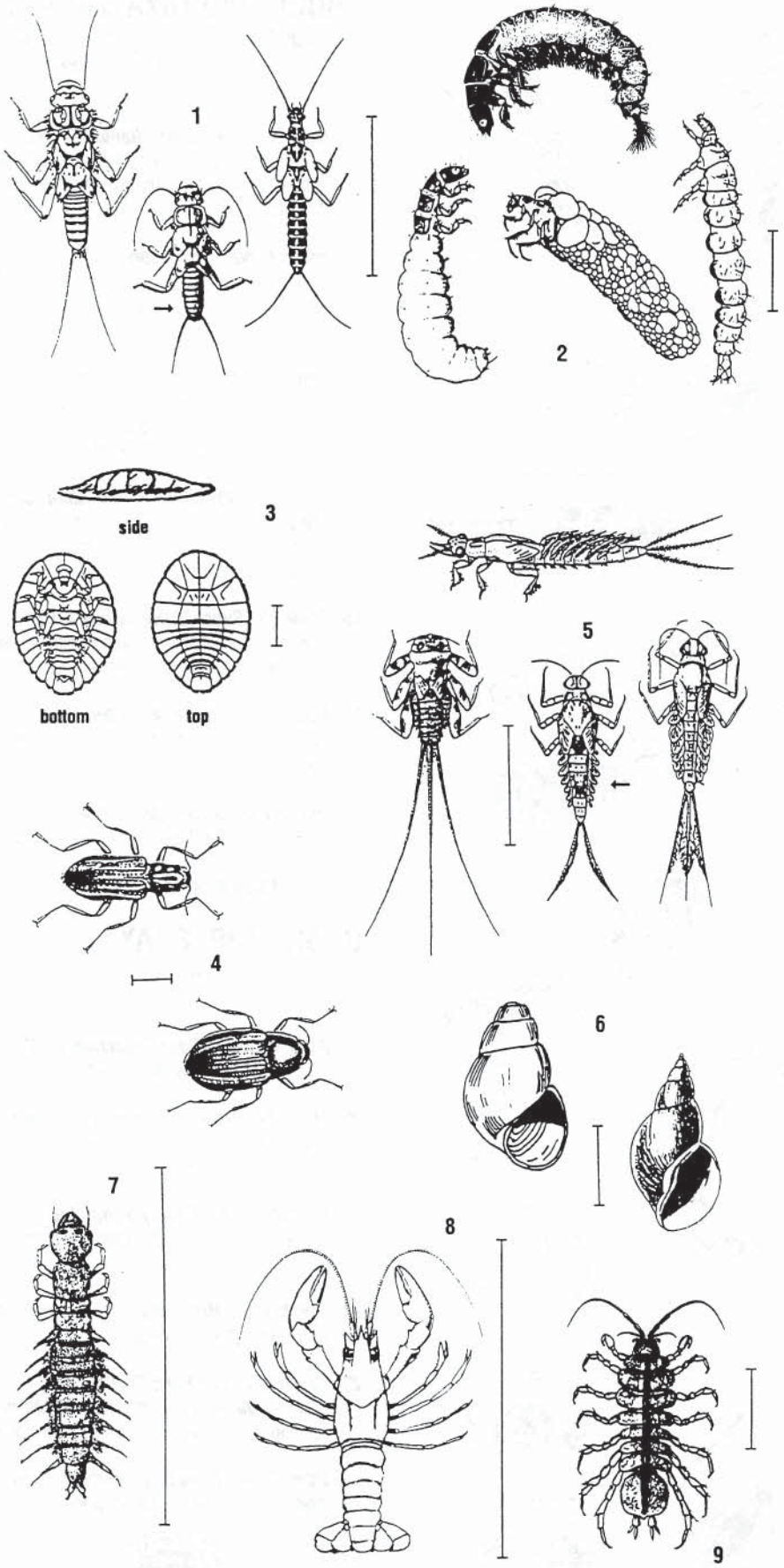
Extensions: Have students draw the creatures they observe. A good place for these drawings is a field notebook. See the activity "Naturalist Notebooks" in this chapter. Encourage students to research these animals' life histories.

Have students examine the macroinvertebrates under a field microscope or hand lens.

Because kick-nets can be difficult for younger students to handle, this activity can be done with students collecting macroinvertebrates with hand-held strainers.

References: For more information refer to the "Save Our Streams" program of the Izaak Walton League of America, 707 Conservation Lane, Gaithersburg, MD, 20878-2983, and the Adopt-a-Stream Foundation of Everett, WA.

Stream Insects & Crustaceans



Bar lines indicate relative size

GROUP ONE TAXA

Pollution sensititve organisms found in good quality water.

1 ***Stonefly: Order Plecoptera.*** 1/2" - 1 1/2", 6 legs with hooked tips, antennae, 2 hair-like tails. Smooth (no gills) on lower half of body. (See arrow.)

2 ***Caddisfly: Order Trichoptera.*** Up to 1", 6 hooked legs on upper third of body, 2 hooks at back end. May be in a stick, rock or leaf case with its head sticking out. May have fluffy gill tufts on underside.

3 ***Water Penny: Order Coleoptera.*** 1/4", flat saucer-shaped body with a raised bump on one side and 6 tiny legs and fluffy gills on the other side. Immature beetle.

4 ***Riffle Beetle: Order Coleoptera.*** 1/4", oval body covered with tiny hairs, 6 legs, antennae. Walks slowly underwater. Does not swim on surface.

5 ***Mayfly: Order Ephemeroptera.*** 1/4" - 1". brown, moving, plate-like or feathery gills on sides of lower body (see arrow), 6 large hooked legs, antennae, 2 or 3 long, hair-like tails. Tails may be webbed together.

6 ***Gilled Snail: Class Gastropoda.*** Shell opening covered by thin plate called operculum. When opening is facing you, shell usually opens on right.

7 ***Dobsonfly (Hellgrammite): Family Corydalidae.*** 3/4" - 4", dark-colored, 6 legs, large pinching jaws, eight pairs feelers on lower half of body with paired cotton-like gill tufts along underside, short antennae, 2 tails and 2 pairs of hooks at back end.

GROUP TWO TAXA

Somewhat pollution tolerant organisms can be in good or fair quality water.

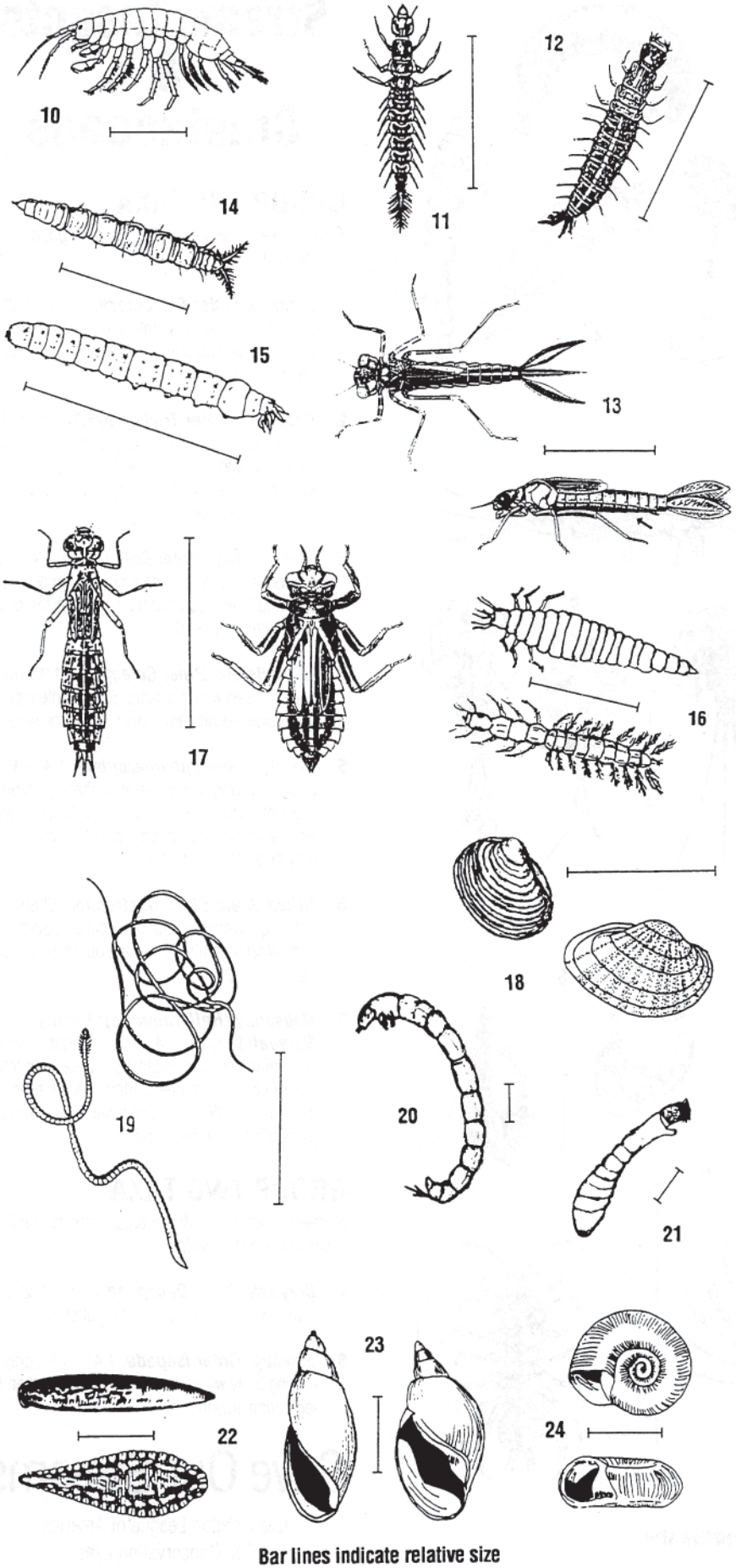
8 ***Crayfish: Order Decapoda.*** Up to 6", 2 large claws, 8 legs, resembles small lobster.

9 ***Sowbug: Order Isopoda.*** 1/4" - 3/4", gray oblong body wider than it is high, more than 6 legs, long antennae.

Save Our Streams

Izaak Walton League of America
707 Conservation Lane
Gaithersburg, MD 20878-2983
1(800)BUG-IWLA

1/95



Bar lines indicate relative size

GROUP TWO TAXA CONTINUED

10 ***Scud: Order Amphipoda.*** 1/4", white to grey, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp.

11 ***Alderfly Larva: Family Sialidae.*** 1" long. Looks like small hellgrammite but has 1 long, thin, branched tail at back end (no hooks). No gill tufts underneath.

12 ***Fishfly Larva: Family Corydalidae.*** Up to 1 1/2" long. Looks like small hellgrammite but often a lighter reddish-tan color, or with yellowish streaks. No gill tufts underneath.

13 ***Damselfly: Suborder Zygoptera.*** 1/2" - 1", large eyes, 6 thin hooked legs, 3 broad oar-shaped tails, positioned like a tripod. Smooth (no gills) on sides of lower half of body. (See arrow.)

14 ***Watersnipe Fly Larva: Family Athericidae (Atherix).*** 1/4" - 1", pale to green, tapered body, many caterpillar-like legs, conical head, feathery "horns" at back end.

15 ***Crane Fly: Suborder Nematocera.*** 1/3" - 2", milky, green, or light brown, plump caterpillar-like segmented body, 4 finger-like lobes at back end.

16 ***Beetle Larva: Order Coleoptera.*** 1/4" - 1", light-colored, 6 legs on upper half of body, feelers, antennae.

17 ***Dragon Fly: Suborder Anisoptera.*** 1/2" - 2", large eyes, 6 hooked legs. Wide oval to round abdomen.

18 ***Clam: Class Bivalvia.***

GROUP THREE TAXA

Pollution tolerant organisms can be in any quality of water.

19 ***Aquatic Worm: Class Oligochaeta.*** 1/4" - 2", can be very tiny; thin worm-like body.

20 ***Midge Fly Larva: Suborder Nematocera.*** Up to 1/4", dark head, worm-like segmented body, 2 tiny legs on each side.

21 ***Blackfly Larva: Family Simulidae.*** Up 1/4", one end of body wider. Black head, suction pad on other end.

22 ***Leech: Order Hirudinea.*** 1/4" - 2", brown, slimy body, ends with suction pads.

23 ***Pouch Snail and Pond Snails: Class Gastropoda.*** No operculum. Breathe air. When opening is facing you, shell usually opens on left.

24 ***Other Snails: Class Gastropoda.*** No operculum. Breathe air. Snail shell coils in one plane.

DEFENDERS OF SOIL, AIR, WOODS, WATERS AND WILDLIFE
THE IZAAK WALTON LEAGUE OF AMERICA, INC.

10. *A Rose by Any Other Name*

Description: Students learn about the process of naming and studying plants by selecting and observing a plant, naming it, and sharing their observations and names with fellow students.

Objective: Students learn:

- that they do not need prior knowledge to identify and enjoy plants;
- about methods of identification and classification of plants;
- some common terms used to describe plants; and
- some methods of plant identification and classification.

Materials: Although this activity can be conducted without any materials, the following items may be useful to have:

paper and clipboards

colored pencils

magnifying glasses or hand lenses

copies of student pages

field guides (see ***Resources*** for suggestions)

Background: Have you ever wondered why plants have the names they have? Is there anything special about the names of plants? The world of plant names is a fascinating realm to explore. Often, understanding the name(s) of a plant helps us understand and appreciate the plant itself.

Most plants have several names. The common name is the name most people use for a plant. Each language may have its own common name for an individual plant, and often, especially for plants that have wide geographic ranges, there is more than one common name for each plant. These common names are also used

10. A Rose by Any Other Name

Grades: 4–8

Time: 45 minutes to an hour and half, depending on class size

Subjects: science

Terms: *scientific nomenclature, genus, species, binomial*

for different plants, especially in different regions. Using only common names can result in much confusion. Since many plants have important properties, such as medicinal or food uses, it is important to communicate very clearly about which plant you are discussing.

Carolus Linnaeus (1707–1778), a Swedish scientist, developed a system (*Species Plantarum,* 1753) for giving each plant species its own unique name. This name is called the plant's "scientific name" and follows Linnaeus's formula for "scientific nomenclature." The species name, sometimes called a binomial, has two main parts: the genus and the specific epithet (descriptor). Other parts of the species name include the author(s) who have first identified the plant and the family name that groups related genera (plural of genus) together.

Virgin's bower *(Clematis ligusticifolia)*

The genus is the first word in the binomial and is always capitalized. Although it comes first, it is more like a person's last name. The genus describes a group of plants that are related. The second word, or the specific epithet, is unique within that genus to one species of plant. It is usually not capitialized. It is easy to think of the specific epithet like someone's first name. For example, at school there may be several people named Katie, but in a family there is usually only one person with that name. To keep the Katies straight at school, a last name is often used. This is usually the same last name as other members of each Katie's family. People familiar with Katie's brother may be able to recognize that she is related to him either by her last name or by similar features.

Plants are like that too. The scientific name for the cottonwood found in the Middle Rio Grande bosque is *Populus deltoides* var. *wislizenii.* These names mean it is a tree (wood) with cottony seed. The genus *Populus* shows it is a poplar tree; *deltoides* refers to the leaf shape (deltoid or triangular); and the last name is for Frederick A. Wislizenus, who collected plant specimens in New Mexico in 1846.

There are several kinds of poplars or cottonwoods that grow in New Mexico. The Fremont cottonwood found in the San Juan and Gila Rivers is *Populus fremontii. Populus angustifolia* or narrowleaf

cottonwood grows along mountain streams. Another mountain tree is quaking aspen, or *Populus tremuloides.* Although these trees are all in the same genus (*Populus*), they are each individual species. When both the genus and the specific epithet are used together, they are known as the species name.

When scientists discover a plant that has not been described before, they get to name the plant. Sometimes they name the plant for themselves or for people they admire. Sometimes they name the plant for some unique features that the plant has. Often the location where the first plant of that species was found is part of the name.

In order for scientists to claim the "discovery" of a new plant, and thus get the honor of naming the plant, they must write and publish a description of the new species. They need to describe what the species looks like, including the features of the flowers, fruits, leaves, etc. They need to explain where it grows and attempt to describe the geographic range of the plant. They need to explain what other plants this new species is related to, and what makes it different from its closest relatives. They must do this writing all in Latin!

Sometimes more than one person will assign a plant a name. The International Association of Plant Taxonomy governs the process of naming and has rules for resolving naming disputes. There are two codes (The St. Louis code and the Tokyo code) for deciding the proper name. Botanical congresses convene regularly to sort out any confusion.

Botanists have many words to describe very specific features of plants. The Guide to Observing Plants in this activity illustrates some of these terms for identifying various plant features, leaf shapes and arrangements, and flower and fruit types. The sidebar defines some common botanical terms.

Procedure:

1. Ask students to name some of the plants they know. Does anyone know why the plant has that name? Discuss the kinds of names that plants have (see ***Background***).
2. Explain that scientists and explorers sometimes name plants. Today the students are going to be explorers and find "new" plants (actually, it is okay for students to select any plant, but preferably a plant that is new to the student.) They will make up their own names for the plants based on their observations. Explain that once the students find, make observations on, and name a plant, the group will take a "guided nature hike" and every student will get to show his or her classmates a plant and explain its new name.

3. Designate boundaries for the area where students can search for plants. This could be as simple as "do not get out of sight of this 'designated landmark'." Also designate a meeting time and a meeting place for students to return to start the nature hike.

4. Ask students to select a plant that they would like to observe and name. Students should draw the plant or take notes about it. Students may want to refer to the Guide to Observing Plants student page to help describe the shape and arrangement of its leaves and characteristics of the flower or fruit. Students can also look for clues about where the plant grows. Does it seem to like the sun or the shade? Does it appear to need lots of moisture? Are there any plants that it seems to grow next to? What does the plant feel like? Does it have a smell? Does it make a noise when the wind blows? Once students have at least three interesting observations about the plant, they can create a name or names (common and/or scientific, or in other languages) for their plant.

Sacred datura *(Datura wrightii)*

5. While students are exploring the designated area and selecting, observing, and naming plants, circulate among the students to assist with individual questions. Most students will need five to 10 minutes for this part of the activity.

6. Assemble the group together again, and explain that the group is going on a guided nature walk to each person's plant. Ask a student to lead the group to his or her plant. Have the student introduce the group to his or her plant and explain his or her name for the plant. Ask if any other students selected the same kind (species) of plant. What was their name? Ask the students to share at least two of the special observations they have made. If you know the plant, you can add additional information about the plant here, but the activity works well without any previous plant knowledge. Ask if any other students have a plant nearby and move on to the next plant until all students have shown and discussed their plant.

Assessment: Assessment can be based on participation and noting the care and quality of the students' observations.

Extensions:

1. Students may want to learn more about their plants. With field guides, and even the plant identification cards in the "Who Grows Where?" activity, they can try to identify the plants they have become familiar with on their nature hike. An easy way to learn new plants is to invite someone who knows the plants of an area along to teach them to you.
2. Students may want to research the different names for their plants. Most field guides give both the English common name or names and the scientific name. Spanish plant names can be found in many sources as well. Interviews are another excellent way to collect common names for plants. A list of web sites for plants is included below.

Resources/ References:

There are many references to help with plant study and plant identification. Complete citations can be found in Appendix B, but here is a quick list of field guides that have plants that occur in the bosque.

Allred, Kelly. 1997. A Field Guide to the Grasses of New Mexico, 2nd. ed. Agricultural Experiment Station, New Mexico State University, Las Cruces.

Dunmire, William, and Gail Tierney. 1995. Wild Plants of the Pueblo Province. Museum of New Mexico Press, Santa Fe.

Ivey, Robert DeWitt. 1986 and 1995. Flowering Plants of New Mexico. R.D. Ivey, Albuquerque.

There are also many web pages that contain information about plants. Here is a list of some of them:

A Working Index of New Vascular Plant Names is maintained by Kelly Allred at NMSU. All alien species are marked with an asterisk (*). This list is available on the web at http://web.nmsu.edu/~kallred/herbweb/

Here are some other web sites as well.

www.hcs.ohio-state.edu
www.noble.org
www.desertusa.com
www.biosurvey.ou.edu
www.laspilates.com
www.fs.fed/database
www.nrcs.gov/plants

Annual sunflower *(Helianthus annus)*

Guide to Observing Plants

When you are trying to identify a plant, there are several observations you can make. Follow this guide and answer the questions to help you identify your plant.

1. Is your plant a tree, a shrub, a forb, a graminoid, or other?

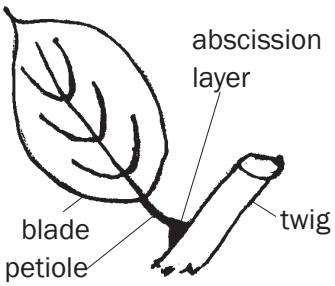
If it has a woody base, it is a tree or a shrub.

If it has a woody base and, when mature, it is over 10 feet (3 m) tall, it is a tree; otherwise it is a shrub.

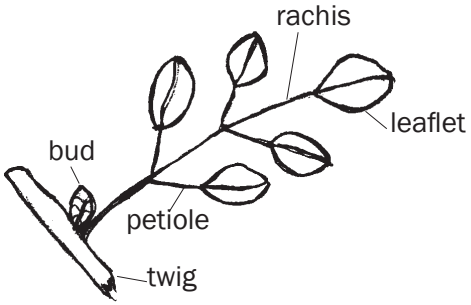
If it does not have a woody base but it looks like a grass, call it a graminoid. If it doesn't look like a grass but it is an herb, call it a forb.

If it doesn't fit any of these categories, call it other.

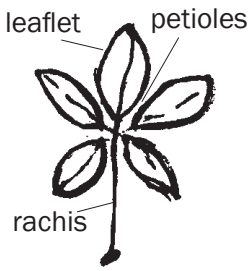
2. Now look closely at the leaves. Identify the basic leaf parts: blade, leaflets (if compound), petiole, etc. Determine if your leaf is simple or compound. If it is compound, is it pinnately compound or palmately compound?



simple leaf



pinnately compound leaf

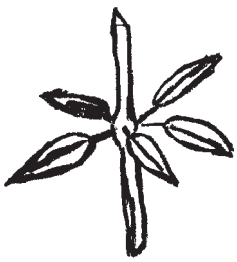


palmately compound leaf

3. How are the leaves arranged on your plant?

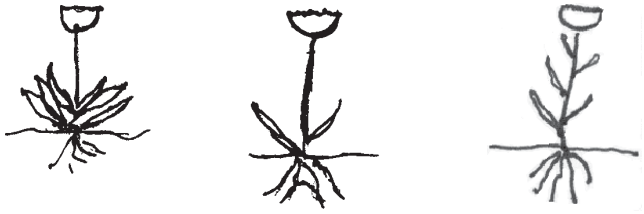
opposite

alternate



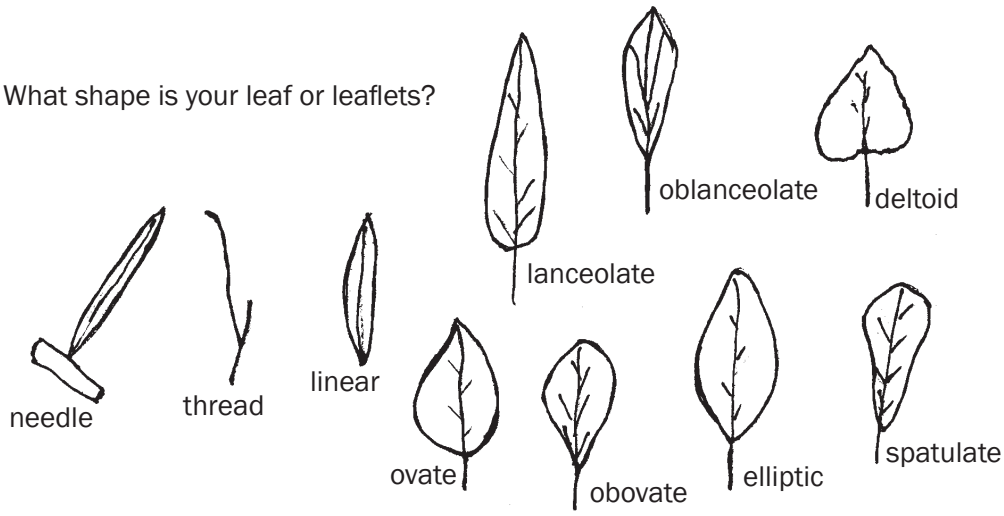
whorled

4. If your plant is a forb, where do the leaves grow?

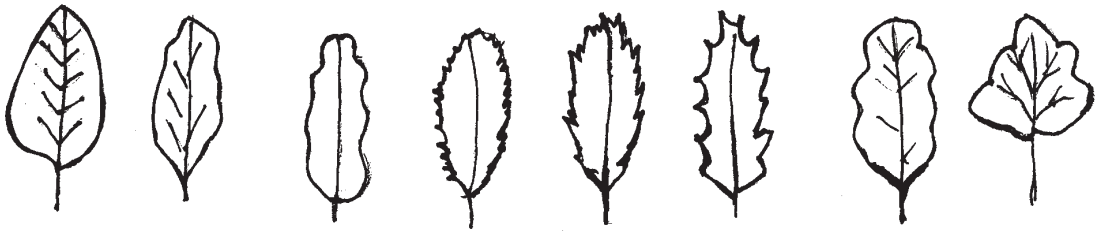


rosette basal along the stem

5. What shape is your leaf or leaflets?

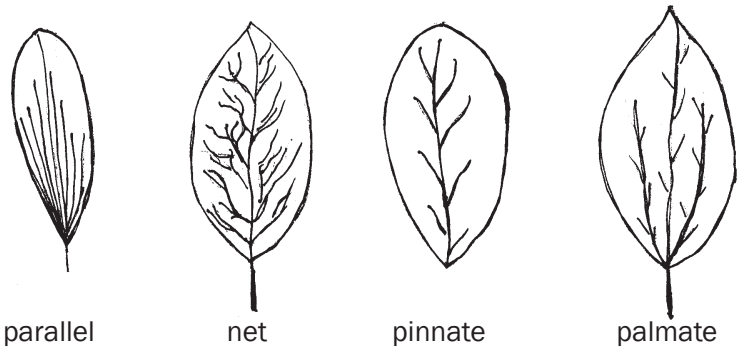


6. What kind of margin (or edge) does your leaf have?



entire wavy sinuate serrate double serrate dentate (toothed) lobed

7. What kind of pattern do the veins in your leaf make?



parallel net pinnate palmate

Common Botanical Terms

Botanists use many special words to describe plants in very precise ways. Many of these words are very specific to distinct features, so they are not used in normal conversation. They are true English words, though (and legal for use in Scrabble®!).

Here is a list of some of the more common botanical terms that are used in this Guide to Observing Plants. Most of these terms are from *Plant Identification Terminology: An Illustrated Glossary,* by James G. Harris and Melinda Woolf Harris, published in 1994 and 2001 by Spring Lake Publishing of Payson, Utah.

tree: a large, woody plant that at maturity is over 10 feet (3 meters) tall

shrub: a woody plant, usually with several stems, that is generally under 10 feet (3 meters) tall

herb: a non-woody plant; stems die back to the ground at the end of the growing season; herbs include graminoids and forbs

grass: an herb that is in a family of plants that has jointed, tubular stems, leaf parts that include a sheath, ligule, and blade, and modified flowers that produce grains

graminoid: an herbaceous plant that either is a grass or looks like a grass

forb: a non-grasslike, herbaceous plant

simple: undivided, as a leaf blade not separated into leaflets

compound: with two or more parts in one organ

opposite: having two parts across from each other at each node, as in leaves on a stem

alternate: having only one part at each node, as in leaves on a stem

blade: the broad part of a leaf or petal

petiole: a leaf stalk

rachis: the main axis of a structure, such as a compound leaf or an inflorescence (cluster of flowers)

abcission layer: a thin wall of cells at the base of the leaf petiole that breaks down and causes the leaf to fall

node: the position on the stem where leaves or branches originate

internode: the portion of the stem between two nodes

rosette: a dense, radiating cluster of leaves

basal: positioned at or arising from the base, as leaves arising from the base of the stem

clasping: wholly or partly surrounding the stem

pinnate: resembling a feather, as in a compound leaf with leaflets arranged on opposite sides of an elongated axis

palmate: divided from a common point, like fingers on a hand

lanceolate: lance-shaped; much longer than wide, with the widest point below the middle

oblanceolate: inversely lanceolate; much longer than wide, with the widest point above the middle

deltoid: with the shape of the Greek letter delta; shaped like an equilateral triangle

needle: a slender, needle-shaped leaf, as in pine trees

thread: a thin leaf, like a thread without fleshy tissue on each side of the blade

linear: resembling a line; long and narrow with more or less parallel sides

ovate: egg-shaped in outline and attached at the broad end

obovate: egg-shaped in outline and attached at the narrow end

elliptic: in the shape of an ellipse, or narrow oval; broadest in the middle and narrower at two equal ends

spatulate: like a spatula in shape, with a rounded blade above gradually tapering to the base

sinuate: with a strongly wavy margin

serrate: saw-like, toothed along the edges, the sharp teeth pointing forward

dentate: toothed along the margin or edge, the teeth directed outward rather than forward

lobed: bearing rounded divisions or segments which are cut less than half-way to the base or mid-vein

net-veined: in the form of a network; reticulate

flower: the reproductive part of a plant

petal: generally the showy, colored part of a flower, yet determined by position in relation to other plant parts (i.e., above the sepal)

sepal: the outer parts of a flower, typically a green bract that is below the colored petal

stamen: the male reproductive organ in a flower, consisting of a stem called a filament and the head called the anther which contains the pollen

pistil: the female reproductive organ in a flower, consisting of the ovary where the seed develops, the stigma where the pollen enters, and the style that transports the pollen from the stigma to the ovary

annual: a plant that grows from a seed, flowers, sets seed, and dies in the same year

biennial: a plant that lives two years, usually forming a basal rosette of leaves the first year; the second year it flowers and fruits, and then dies

perennial: a plant that lives three or more years

11. *Reading the Bosque*

Description: Students interpret the bosque on a field trip using individual informational clue cards.

Objective: To help students learn to observe and make inferences from their observations about the ecological processes in the bosque.

Materials: photocopies of clue cards

appropriate field trip equipment (water, hat, etc.)

Background: When we read, we interpret many symbols (letters) that make up the words. The words make up sentences that express ideas. Reading is a process of understanding others' thoughts by making sense of many smaller symbols. We use reading or decoding skills in other areas as well. For example, musical notes on a scale are symbols we translate into melodies and songs.

Naturalists are adept at "reading" the landscape. That means that they can infer what is happening, or has happened, or might happen in the future, by looking at the clues and translating them into a larger understanding of the ecosystem. Reading the landscape requires building an understanding about what your observations mean. For example, a person looking at tracks in a trail might say, "Look, an animal walked here." A more experienced observer might be able to identify the animal based on the shape of the track. An expert might add when the animal came by, what other animals it was with, and maybe even what it was doing. Like any other kind of reading, the more you read the landscape, the better you can interpret what you see. Unlike reading words, landscape reading is not an exact science. People often interpret ecosystem "stories" in different ways.

11. Reading the Bosque

Grades: 4–12

Time: one field trip to the bosque, about two hours

Subjects: science

Terms: *cohort, forbs, germinate, meander, riparian, sediment, snags, water table*

As you go through this activity with students, they will develop knowledge and a better understanding of how to "read the bosque," or how to interpret the riparian area to tell a story about the past and the present.

Procedure: Introduce the idea that from our observations we know things. For example, if the box is empty, we know that all the cereal is gone. If the sun is streaming through our window, and our parents are yelling at us to get up, we know it is morning. Much of what we know about the world around us is by observation through our senses (sight, smell, hear, taste, touch.) Explain that what we know about the bosque comes from our observations. By learning what our observations mean, we can know the bosque better.

In reading we use words, together in sentences, to share ideas. In reading the bosque landscape, we learn to identify the elements of the bosque, such as a type of plant, but in order to learn about the larger ecosystem we use observations and put together many elements to understand a bigger story.

There are 24 Clue Cards. Use one per student or pair of students. A few cards are seasonal, such as when the cottonwoods are sending out seeds and it seems like it is snowing; but cottonwood cotton can usually be found year-round if you look. Symbols for the appropriate seasons are on each card.

Hand out the cards to students and explain that *they will be the experts* as they walk in the bosque. Each card has an introductory question or something to look for. They should read through and figure out what that is. You should go over terms they will be using. As you walk, when they see the item referred to, the whole group should stop and learn from the expert about it. They can read the paragraph or, better, having read it before, they tell the information to the whole group in their own words.

As facilitator, you may have to stop the group and say, "Does someone have some information about ____?" in order to remind the students that this is a good place to share a particular card.

Adapting to younger students: Some of the items are fairly simple. You could take the theme of looking for stumps as a focus for a trip, and at each stump you think about what happened for that tree to fall. Looking for antlion pits, stumps, harvester ant hills, pocket gopher mounds, seasonal signs, bark beetles, jetty jacks, lacy leaves and isopods, tracks and scat would be within the realm of younger students. You will need to summarize the information for their level.

Resources: The "Changing River" activity (#13) will give an overview of the concepts in this activity.

Clue Cards

What this tells us:

Cottonwoods usually live where water is abundant. This would be true in the riparian zone of a river in its natural condition. When cottonwoods do not get enough water, they become unhealthy. They often have dead branches with dry, brown leaves. Some of their branches may fall off due to drought stress. In some trees you can see a dark liquid coming from where a branch fell off. These trees may be more susceptible to attacks by insects. Healthy trees have full leaves and branches.

(1) Look at the state of individual cottonwoods. How can you tell a healthy from an unhealthy cottonwood?

The presence of these shrubs (that typically grow up on the mesas) in the bosque suggests that the water table is fairly deep or that the area no longer floods. Upland shrubs do well in the bosque when the ground water level drops. This is typical along regulated rivers (dams regulate the flow of the river). These shrubs do not require as much water as the typical riparian shrubs like New Mexico olive or coyote willow. Juniper is a good indicator of a deep water table in the bosque, because it does not do well in moist soil.

(2) Look for shrubs such as juniper, snakeweed or saltbush in the bosque. What does their presence indicate?

What this tells us:

If the tree stump is cut straight across and even, it was cut by a person using a saw. Sometimes trees are taken from the bosque for the wood. In some areas a tree might be cut down so that it does not fall on people using a trail.

(3) Look for a tree stump that is cut flat across.

4) Look for a tree stump with teeth marks along the cut.

What this tells us:

It was cut by a beaver. Along the Rio Grande, beavers cut trees to use for food. After the tree falls, if it is a large tree they take off the branches to use, but they do not eat the trunk. For small trees, they take the whole tree. They eat the layer of tissue underneath the bark, called the cambium.

5) Look for a tree stump with jagged edges.

What this tells us:

The tree blew over, perhaps in a strong wind. This often happens to trees that are damaged by fires or by drought stress. Often these tree stumps are different heights, as the trees break off at different places.

(6) Look for piles of soil about 1 foot (30 centimeters) across.

What these tell us:

These are gopher mounds. They are very common in the bosque, because gophers are able to dig easily in the soil near the river. The gopher digs a tunnel underground, then pushes all of the soil taken from the tunnel up through the hole to the surface. It usually fills in the hole so that predators can't get in as easily, so typically you will not find a hole in the pile of soil. Gophers spend most of their lives underground. Many desert plants have enlarged roots or other underground storage parts that store nutrients and water for the plants. Gophers tunnel to get to these underground parts of plants, which are their favorite foods. Being underground also helps the gopher avoid predators, as well as extreme hot and cold temperatures.

Some examples:
a) Spring—cottonwood flowers. Cottonwoods flower only in the spring, usually around April in the Middle Rio Grande Valley. The exact date varies among years, and flowers come out earlier in more southern areas. The red catkins of male flowers are easier to see than the green female flowers.
b) Winter—flock of crows roosting in cottonwoods. Large numbers of crows roost in the bosque during the winter. In the summer, most of them head north to breed, but some stay in the valley.
c) Fall or spring—V of cranes flying overhead. Large numbers of waterfowl (ducks, geese, cranes) migrate along the Rio Grande. In the spring, they can be seen flying north. They fly south in the fall.

(7) What things do you notice in or near the bosque that tell you what time of year it is?

What these tell us:

An antlion larva (also called a “doodlebug”) lives here. Antlion larvae (which eventually become adults that fly) hide at the bottom of small, conical pits that they make in sand or fine dirt. They wait to catch ants and other small insects that fall into the pit. Antlions have large jaws to catch their prey. What other holes can you find in the bosque? Can you tell what made them?

(8) Look for small pits in the sand—2 inch (5 centimeter) funnel-shaped depressions.

What this tells us:
When the snow melts high in the mountains and the streams swell with water, the river naturally swells as well. When so much water comes down the river that it no longer stays in the channel but flows over the banks, this is called overbank flooding. Today we have several reservoirs that capture and hold this spring runoff to make water available later in the summer for farming. Therefore, not as many places in the bosque today experience overbank flooding. There are special places close to the river’s edge that still flood on a regular basis. One way to identify these spots is to look for mud rings on the trees. The spring water carries many sediments that are deposited in the forest. The height of the mud rings indicates the depth of the flood water. Soils that are wetted regularly also develop cracks when they dry out. What other signs of regular flooding do you see?

(9) Look for cracks in the soil and rings of mud at the base of the trees.

(10) Look for animal chew marks on trees. Are they left by a beaver or by a porcupine?

What this tells us:
a) Trees are cut by beavers. Beavers cannot climb trees, so they only bite as high as they can reach while standing on the ground. They often chew trees completely through.
b) Porcupines can climb high into trees, and they prefer to eat up high where they are safe from predators. Porcupines may chew the bark off all the way around a branch or trunk, but they do not cut the whole tree down like beavers do. They often chew the bark off in large patches that do not go around the tree.
Both animals eat the inner bark, the growing part called cambium. Beavers cut trees down to get to the tender branches to eat, porcupines climb up into trees to get the same food.

(11) Do you see any charred stumps or snags (standing dead trees)?

What this tells us:
The site was burned by a fire. Fires may not have been an important part of the bosque ecosystem before the river ecosystem was changed and flooding was reduced. When the bosque flooded regularly, the wetter ground did not carry fire, the branches that fell decomposed faster with the added moisture—a log that would take 70 years to decompose today took only 10 years when there was regular overbank flooding. This downed wood contributes to very hot fires that do a lot of damage in the bosque today. A fire will often kill the main cottonwood trees; though some will re-sprout at the stump or roots after a fire. Most bosque fires are started by humans. What can you do to help reduce the risk of fires damaging the bosque?

(12) Look for a mound of sand with a wide circle of bare ground around it—and lots of ants!

What this tells us:
This mound with a hole in it was made by harvester ants. Harvester ants build large, underground nests over nine feet (three meters) deep with many storage chambers. They eat seeds, which they collect from the area around the nest and then carry underground. Sometimes they also eat other small animals such as isopods, which they sting and carry underground. The ants carefully tend the mound outside the nest. They place bits of dead plant material, small stones, and, sometimes, tiny bits of leaves on the surface of the mound, probably to trap warmth from the sun. Sometimes there are also skeletons from isopods. Often small trails can be seen going out from the nest; worker ants forage along these, looking for seeds.

What this tells us:

The trails were made by bark beetles. Adult bark beetles bore through the bark of a tree and make tunnels between the bark and wood, in which they lay their eggs. The young, called larvae, also make tunnels under the bark. Sometimes, if there are enough of them, the beetles can kill a tree by making these tunnels. If the numbers of beetles are low, this will not kill the tree.

(13) Inspect fallen logs carefully. Can you find any small trails cut into them where bark is falling off?

What we can learn:

The river flows faster on the outside edge of a bend, or meander. The swift water cuts into the outer bank, eroding away some of the soil and cutting a sharp bank on that side. On the inside of the bend, the water moves more slowly. This slower-moving water drops some of the sediment (dirt) it carries, along the edge of the meander. The sediment gradually builds up, pushing the inner bank out into the river to form a sand bar. This is how the course of a river moves, by eroding and depositing sediment.

(14) Look for a meander of a river. Can you tell which side of the river is moving faster?

What this tells us:

Cottonwood seeds germinate (sprout) on sand bars or open areas where conditions are favorable—with plenty of light and moisture available. Typically, when conditions are good, many seeds will germinate along the same stretch of ground. This results in a whole group of trees growing-up together in a patch that are the same age. We call this group of same-aged trees a “cohort.” Trees the same age are not necessarily the same size. The diameter can vary. However, trees the same age are generally in the same size class. This means that although the diameter may vary, they are generally the same height and roughly the same size.

(15) Look at a group of cottonwood trees. Are they all the same age?

(16) What are the big metal structures in the bosque?

These are called Kellner jettys, jacks, or "jetty jacks." Jetty jacks were put in along the river by the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation, starting in the early 1950s. They helped to straighten the river and protect the levees. They work by slowing the speed of the river, which causes sediment (dirt) to drop out of the water. As the dirt builds up, riparian plants can start to grow. This helped keep the river bank in one place, and prevent it from moving across the floodplain. This also protected the levees in case of a flood, so floodwater wouldn't erode the levees. Today, engineers say they are not needed and some are being removed. Levees can be built to withstand floodwaters without the jacks.

(17) Look for cottonwood trees with a single trunk and ones with several trunks from the base. What causes the difference?

A cottonwood can grow from a seed, by sprouting from an existing trunk or a shallow root. The cottonwood with a single trunk grew from a seed. The group or cluster of trunks grew from sprouts called "suckers." Cottonwoods grow suckers in response to many types of disturbances that cut down the original tree. Examples include being cut by a beaver, being burned by a fire, or being knocked over by a flood. Usually the underground roots are not bothered by these things, and the tree is able to sprout again. When it does, it typically sends up several stems instead of just one. This results in clusters of trees that come out of one base. Sometimes they look like separate trees because dirt has covered up the area where the trunks are joined, but you can still see that the trees are grouped close together.

(18) Can you find a "lacy" leaf? Look at the fallen leaves on the ground.

What this tells us:
This leaf was eaten by isopods (pillbugs, woodlice). The isopods eat away the soft tissue of the leaf and leave behind the tougher veins, giving the leaf a lacy appearance. Isopods are crustaceans (related to shrimp and crabs). They have gill-like structures for breathing, so they need to be in moist areas. The most common type of isopod in the bosque rolls up when disturbed. Another kind cannot roll up and instead moves faster. Females can hold 200 eggs in a brood pouch on their undersides. Isopods are the main chewer of fallen cottonwood leaves in the bosque. They start the process of decomposition that is an important part of the nutrient cycle—providing necessary nutrients to plants and animals in the bosque ecosystem.

What this tells us:

This leaf was rolled by the caterpillar of a leaf-roller moth. The caterpillar folds the leaf around its body and ties it with silk. Sometimes more than one leaf is tied to other leaves. The larva lives inside this rolled leaf until after it changes form (metamorphoses) – first into a pupa and then into a moth. Sometimes if you unroll these leaves you will find the old skin from the pupa that changed into a moth.

(19) Can you find a rolled-up cottonwood leaf?

What this tells us:

These tracks were made by a raccoon—they tell you that a raccoon was here. The tracks left by the front feet of raccoons look like small hands, so they are easy to identify. Raccoons often walk along the mud or wet sand in the riverbed, or along the shore, as they look for food. They like to eat aquatic animals such as frogs and crayfish.

What other tracks can you find in the bosque and along the river?

(20) What do raccoon tracks tell you? Can you find any?

What this tells us:

Yerba mansa (*Anemopsis californica*) grows in moist areas, or places with a high water table. The presence of this plant in the bosque tells you that the water table is probably fairly high (or near the surface). It has been used medicinally for generations. Maybe you can ask an elder about this plant.

(21) Look for yerba mansa, a thick-leaved, succulent, low plant. What does this plant tell you?

(22) Can you find any coyote scat (droppings) and what can you tell from them?

What this tells us:

"Scat" is a name used by biologists for "poop." You can tell a lot about what an animal eats by looking at its scat. For example, coyote scat will have small bones and fur in it if the coyote has been eating mice, or it may have the hard shells from beetles if that is what the coyote has been eating. Or, it may have berries or other bits of plant material. The shape of an animal's scat can often identify the type of animal—look in a book of animal tracks or signs to learn to identify them.

What kinds of scat can you find in the bosque?

(23) Does it look like snow in the summer? Find some cottonwood cotton and inspect it carefully.

What can we learn about these:

Cottonwoods have separate male and female trees. The flowers on male trees are bright red as they emerge, the flowers on female trees produce pea-like fruit that open to release hundreds of cottony seeds. Cottonwood seeds are then carried by the wind on the chance that some will land in the right conditions. They need bare, wet soil to germinate, with lots of sunlight. The roots must stay in the water as the water table drops through the summer.

(24) Can you find baby cottonwoods?

The conditions needed by baby cottonwoods (seedlings) are more rare now, due to flood control and other conditions that have altered the river. As a result there are very few young cottonwoods along the Rio Grande, and many that start are washed away with each year's high water. Land managers are now changing their approach and trying to make conditions so cottonwoods can again thrive in our bosque—allowing overbank flooding in high water years, creating secondary channels and planting cottonwoods.

12. Winter Bud Activity

Description: Students closely observe buds on a winter hike, then do detailed drawings and observations in the classroom.

Objectives: Students will:

- develop skills of observation and recording;
- use inquiry and analogy to make discoveries;
- learn to differentiate trees and shrubs by their buds; and
- understand the function and growth of buds.

Materials: field: field journal and pencils, hand lenses or magnifiers

classroom: plain white paper, colored pencils, hand lenses or magnifiers, tape, rulers, shears or pruner, twigs of assorted broad-leaved plants; optional: vase with water

Background: ". . .The approach of autumn, with its showers of many-colored leaves, spells the end of the season's activities in the identification of deciduous trees and shrubs. Without leaves the members of the forest community, unless they be relatively large, seem to lose much of their summer's identity and may even descend to the level of 'brush'. This is in reality not the case, as may be easily discovered by examining any leafless twig with a 10X pocket lens, or even with the naked eye. A casual glance. . .will also serve to show that woody plants in winter are anything but featureless."—William M. Harlow, Ph.D., 1941 (as reprinted in *Winter Guide to Central Rocky Mountain Shrubs*, 1976)

Deciduous trees and shrubs, those that lose their leaves in winter, may look dead without their leaves, but in reality they are preparing for the growing season to come. Each type of plant is very different when examined carefully. Trees may be identified during the winter by observing the position, size, shape and texture of the buds and leaf scars. This activity has students look at twigs carefully.

12. Winter Bud Activity

Grades: 3–12

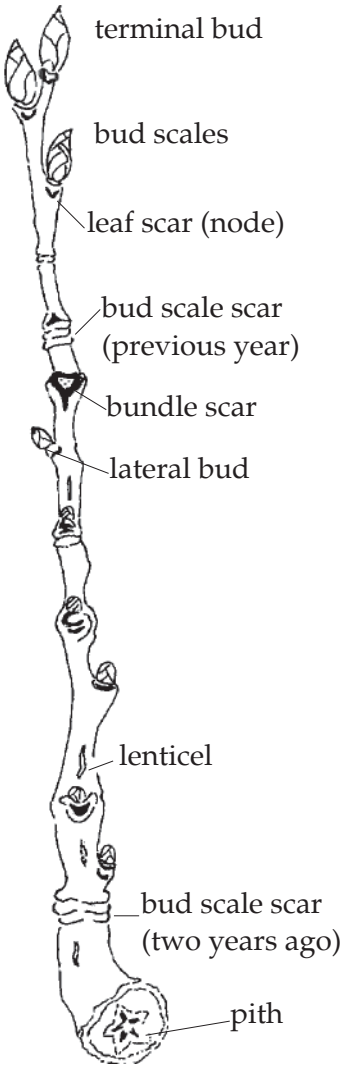
Time: one or two class periods and field exploration

Subjects: science, art

Terms: *bud, bud scales, bundle scar, deciduous, terminal bud, lateral buds, leaf scar, lenticels, node*

Buds begin to form in the autumn when the leaves fall from the trees. **Buds** are the plants' protection from cold and dryness for its new growth. The **scales** that form a cover for this growth are actually modified leaves. Most buds are usually covered with overlapping scales but some are joined along the edges, like a clam shell.

In the seemingly dead twigs, the hormone gibberellin needed for spring growth is forming. This takes place only when it is cold. To use a non-bosque tree as an example, apple trees need 1,000 to 1,400 hours of temperatures below 50° F (10° C) to produce this necessary hormone.



All trees and shrubs develop leaf buds after the leaves fall in the autumn, and flower buds after the flowers are spent and fall off. The leaf buds appear at the **leaf scar** where the old leaf was attached to the twig, also called the **node**. The buds grow slowly all winter, but in spring they develop very quickly. Look at buds any time after the leaves fall off in the autumn to when they emerge in the spring. Our spring extends over many months. Siberian elms are one of the first plants to open their flowers, usually in February, while cottonwoods are several months behind them in April.

Terms:

bud: the encased, developing leaf or flower

bud scales: modified leaves that cover and protect terminal and lateral buds and flower buds

bundle scar: spots in the leaf scar where the exchange of water and nutrients between the leaf and the rest of the plant occurred

deciduous: a plant that sheds all of its leaves in one season

terminal bud: the bud at the end of a twig

lateral buds: the buds growing on the side of the twig. The arrangement of lateral buds (and eventually the leaves) can be:

a. **opposit**e—a pair of buds at the same node, opposite each other

b. **alternate**—one bud at a time along the twig, usually spiraling along it
c. **whorled**—several leaves will emerge from all sides at one node

leaf scar: where last year's leaf was attached to the twig

lenticels: breathing pores for the cells of the inner bark, where gases are taken-in and released

node: the point on a stem where one or more leaves are attached

(See illustrations in "A Rose by Any Other Name.")

Here are some things to look at closely when inspecting buds:

The bud at the tip of the twig is the **terminal bud**. The **lateral buds** on the twig may be attached with a pair of buds **opposite** each other, **alternating** along the stem, or what is called **whorled** where several leaves will emerge from all sides at one position. These are characteristics used in identifying a plant even in winter.

In the scar left after last year's leaf falls, look for several small dots. These were the transportation bundles (**bundle scars**) where the leaf exchanged water and nutrients with the rest of the plant.

Along the stem you can often see small warty spots. Look closely. Are they bugs? They are **lenticels**, breathing pores for the cells of the inner bark, where gases are taken in and released.

The number of years of growth of a twig can be counted by looking for rings around the twig. Each year at the terminal bud scale, scars are left as the twig moves into its new growth, as a set of small rings encircling the twig. You can count the number of terminal **bud scale scars** along a twig and know how many years it has grown. You can also compare different years by measuring the distance between the terminal bud scars—did it grow more one year compared to another year?

Does the plant have spines or thorns? These may be characteristic in differentiating them from other plants.

Is the bark smooth, waxy, fuzzy or hairy?

Break or cut the twig cross-ways. Look at this cross-section of the twig. Is the center a different color? In the cross-section of a cottonwood you should find a surprise: the inner pith (central stem tissue) is in a star shape! This is a characteristic that all trees in the genus *Populus* have.

The classroom activity consists of careful observation and illustration of a twig. Students make written notes describing their twig, illustrate and label the twig and write five analogies about the twig and buds. Analogies help students make personal connections to the object being observed. The students should think about how the twig or bud is similar in some way to something else they know about or have seen. This also can give students practice in theorizing about the natural world and lead them to question why something looks the way it does. This format is adapted from Kerry Ruef's *The Private Eye.*

In the spring, short branches can be cut, brought into a warm room and placed in a vase of water to force the buds to open earlier than they would outside. This allows the students to see the leaves or flowers emerge.

Procedure: Discussion in classroom:

1. Ask the students to tell you what they know about buds on trees and shrubs. List on the board what the students know.
2. What are some questions you have about buds? Write these on the board. Optional: Develop a hypothesis or several hypotheses regarding buds. How can we find out about buds? How can we investigate and test our hypothesis? Encourage students to think about observation as a method for answering questions.

Trip to the bosque:

1. Take a "bud hike." Observe buds on many different shrubs and trees. Feel them, smell them, observe their position, color, sheen, etc. Use magnifiers to closely observe.
2. Each student should choose a bud to draw, measure and take notes on. Older students may wish to study several different buds.
3. Using pruning shears, the teacher can collect a few short, sample twigs from different trees and shrubs. A couple of different twigs for every three or four students are needed. These will be used for an activity back in the classroom.

   Note: Please limit the amount of cutting you do. There are places such as the Rio Grande Nature Center where cutting will not be allowed. We don't want to have a major impact on the vegetation in the bosque so take only a minimal amount.

Classroom:

1. Using the original questions or hypotheses, discuss what was learned on the bud hike. What questions are still unanswered? How can the students find out the answers? Do the students understand the function of the buds?
2. Give each student an 8.5″ x 11″ piece of white paper and a pencil. Have them fold the paper like a science fair display board by having the two sides of the paper meet in the middle. Open it back up and have them put their name on the paper. Pass out the branches with buds to students. Have available magnifiers, rulers, and colored pencils.
3. On the left side of the paper, students should write down as many observations as they can about the buds and the twig.
4. On the right side of the paper, students should write down at least five analogies about the buds (what they look like or what they remind you of).
5. In the center, draw and label the twig with the buds. Students should predict if the buds are leaf or flower buds. (If the twigs are forced as in Step #9, they can see what emerges.)
6. (Optional) Dissect one bud from the branch. Observe and draw. Ask the students what they think the leaves and flowers will look like in the spring. Draw their predictions.
7. Exchange branches with other students and look for differences and similarities.
8. Give an overview of the bud information that is in the ***Background*** section. Have students add to their observation sheet any additional information that they now observe on their twig after the teacher's overview. Add to the drawing if needed.
9. Optional: In the spring, the teacher may bring in some twigs to force the buds to open in the classroom by placing them in water in a warm room. With this, students can observe the flowers or leaves emerging and see the shape of the plants' leaves. Have the students predict which buds will become flowers or leaves.

Assessment: Students' bud observation sheet/drawing—create a rubric for assessment; oral questioning.

Extensions:

1. Begin this activity in the fall and repeat during the late winter and spring. If a trip to the bosque is impossible, observe tree buds on the school grounds or have someone bring in sample buds from the bosque. Have the students make a bud book to take on their bud-observing trips through the school year—

looking for differences as the season changes. (Materials for bud book are white copy paper, cardboard for covers, stapler, colored pencils.)

2. Create a class bud book with the help of the students showing all of the different plants that have been studied.
3. Using analogies about the buds, students may write poems.
4. After the trees have leafed out, students could tape the leaves from the plants they studied into their bud books/observation sheets.
5. Tree silhouettes—observe the shapes of trees and shrubs during the seasons. Sketch or photograph.
6. Observe leaf cells with a microscope.
7. Investigate the differences in the structure of flowers that use wind or insect pollination.
8. Investigate trees like the cottonwood that have male flowers and female flowers on separate trees.
9. Investigate the effect of pruning on branch growth.
10. Record the date that each kind of plant emerges with flowers and leaves. Compare your results from year to year with your students.

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